EXAMINING PAIN ANXIETY IN YOUNG ADULT ATHLETES

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Gillian Potter

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ABSTRACT

Injuries from overuse as well as direct trauma are common among athletes. The ability to respond adaptively to pain may be a function of an athlete's pain anxiety – defined as fearful and anxious responses toward pain. Investigating the underlying constructs of pain anxiety may have important implications for both injury prevention and injury recovery in sport. The objectives of the current study were to examine pain anxiety in a cohort of young adult athletes (Phase 1), and to evaluate the predictability of selected biological, psychological, and social variables on pain anxiety scores (Phase 2). In Phase 1, the Pain Anxiety Symptom Scale-20 (PASS) was used to collect pre-season pain anxiety measures in a cohort of 92 university varsity-level athletes. Results from Phase 1 indicated significant differences between PASS sub-scale ratings. That is, the university athletes primarily reported cognitive manifestations of pain anxiety. Females also reported more pain anxiety compared to males. In Phase 2, a follow-up cohort of 84 athletes from varying levels of play completed the PASS and selected measures purported to predict pain anxiety. Results from Phase 2 were produced through analyses of variance, student's t-tests, and linear regression, and athletes were analyzed across pain group: acute pain athletes (APA) and chronic pain athletes (CPA). A unique set of predictor variables resulted for each pain group. Gender was a strong predictor of APAs' pain anxiety, while pain intensity strongly predicted pain anxiety in the CPA. Contact grades predicted pain anxiety in both groups but the direction of the relationship was dependent on pain type. Finally, neither injury nor pain predicted pain anxiety in APA. These results indicate that sources of pain anxiety differ for athletes with acute and chronic pain. Such findings have important implications for pain management in sport.

More specifically, interventions for athletes without chronic pain could improve by emphasizing the risks of playing through pain and injury, particularly for males, whereas chronic pain athletes may benefit from interventions that account for the challenges of living with high levels of anxiety.

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LIST OF ABBREVIATIONS

ABBREVIATION	MEANING
FAM	Fear Avoidance Model
PASS	Pain Anxiety Symptoms Scale
DASS	Depression Anxiety Stress Scale
AIMS	Athlete Identity Measurement Scale
APA	Acute Pain Athletes
CPA	Chronic Pain Athletes

CHAPTER 1: INTRODUCTION

According to The International Association for the Study of Pain, pain is defined as "an unpleasant sensory and emotional experience associated with either actual or potential tissue damage" (as cited in Rainville, 2002, p. 195). Pain can possess different characteristics, such as acute or chronic. Acute pain is often viewed as pain that lasts less than three months while pain chronicity is commonly viewed as pain that persists for more than three months (Hunt, Silman, Benjamin, McBeth & Mcfarlane, 1999, pp. 275-276). Pain is also described as a protective factor that motivates escape from pain-eliciting stimuli (Woolf, 2004, p. 441). Thus, in many cases, pain serves as conducive to survival and well-being.

When pain research began, it was originally thought that pain merely consisted of nociception, also known as sensory signals sent from the injured (or pathological) site of the body to the brain (Melzack & Wall, 1965, p. 971). However, Melzack and Wall created a platform for understanding the psychological components of pain and how they shape the pain experience (Melzack & Wall, 1965, p. 974). This work led to the Gate Control Theory, which proposed that psychological processes influence pain (Melzack & Wall, 1965, p. 974). In particular, the theory describes how the brain transmits neural activity to a gating mechanism in the lower spinal region to subsequently alter the firing of pain signals sent back to the brain (Melzack & Wall, 1965, p. 976). This theory was significant for the development of the neuromatrix theory, which outlines three components of pain: sensory-discriminative, cognitive-evaluative, and affective-motivational (Melzack, 1999, p. S125).

A unique set of psychological and behavioural responses constitute a construct known as pain anxiety, which McCracken, Zayfert and Gross (1992) describe as "fearful and anxious cognitive, behavioural, and physiological responses to pain" (p. 68). As seen in the short version of the Pain Anxiety Symptoms Scale (PASS), pain anxiety consists of worry and hypervigilance, fearful thought and catastrophizing, escape/avoidance behaviour, and physiological arousal (McCracken &Dhingra, 2002). Pain anxiety can also be seen as a form of pain coping. According to Lazarus (1993), coping is best conceptualized as a process characterized by "ongoing cognitive and behavioural efforts to manage specific demands that are appraised as taxing" (p. 237).

Pain anxiety can be both adaptive and maladaptive. As Tan, Nguyen, Anderson, Jenson, and Thornby (2005) note, the adaptability of a coping response is based on the likely outcome of the individual's physical and psychological well-being (p. 29). Such predictions are contingent on the intensity of the pain anxiety relative to the intensity of the pain stimulus, along with the context of the pain. For instance, high pain anxiety in response to severe pain is adaptive because it promotes avoidance of pain-eliciting stimuli, and ultimately, healing. However, the same response to pain during a required medical procedure would be maladaptive, as exposure to pain in this case is necessary for long-term healing.

One area where the adaptive nature of pain anxiety becomes important is in sport. For athletes, excessive pain anxiety in response to minor pain or even the absence of pain could result in poor injury recovery. Not only have high levels of pain anxiety been linked to increases in pain intensity (Ditre, Zale, Kosiba & Zvolensky, 2013, p. 445; McCracken, Gross, Aikens, Carnike, 1996, p. 929; McCracken et al., 1992, p. 70), but also induced anxiety in both animal and human subjects has been shown to increase sensitivity to pain (Rhudy & Meager, 2000, p. 68-71). Maladaptive pain anxiety could also cause distress in return to play transitions following injury. Due to principles of classical conditioning, pain anxiety can extend toward pain-eliciting stimuli, such as athletic activity (Vlaeyen, Kole-Snijders, Boerin & van Eek, 1995, p. 364; Vlaeyen & Linton, 2000, p. 318). On the other hand, a lack of concern towards serious pain, which is commonly seen in athletes (Deroche, Woodman, Stephan, Brewer & Le Scanff, 2011, p. 584; Madrigal & Gill, 2014, p. 291), could lead to re-injury or the development of chronic pain conditions. Finally, maladaptive pain anxiety also has the potential to hinder athletes' performance abilities, as athletic skill relies heavily on both the physical and psychological condition of the athlete (Birrer & Morgan, 2010, pp. 79-80). Therefore, it is beneficial to identify factors underlying athletes' pain anxiety, especially given that athletes are at risk for injury and pain conditions (Jacobsson et al., 2013, p. 943; Kujala, Taimela &Viljanan, 1999, p. 326).

To examine pain anxiety effectively, a biopsychosocial approach is necessary. Fear and anxiety are influenced by multiple, interconnected factors (Abramowitz & Braddock, 2008, p. 41). This creates a number of vulnerabilities for the development of maladaptive pain anxiety.

Pain and injury are important biological factors to consider in pain anxiety, as pain itself is inherently threatening (Eccleston & Crombez, 1999, p. 362). Therefore, characteristics of the pain, particularly chronicity, will largely determine psychological responses to the pain. In cases of injury, a fear of re-injury can develop, which is closely associated with a fear of pain (Vlaeyen, Kole-Snijders, Rotteveel, Vuesink & Huets, 1995, p. 248).

Pain anxiety may also be a function of psychosocial factors. Multiple forms of anxiety disorders have been associated with pain anxiety (Carleton, Abrams, Asmundson, Antony & McCabe, 2009, p. 793), and characteristics of depression have been said to increase the likelihood of experiencing pain anxiety (Carleton et al, 2009, p. 795; Turner & Aaron as cited in Sullivan, 2009, p. 9; Vlaeyen et al., 1995a, p. 238; Vlaeyen & Linton, 2000, p. 319). Stresses such as those seen in the Type A and Type D personalities, including impatience, agitation, and overreactivity, have also been linked to poor health outcomes (Denollet, 2005, p. 92; Sher, 2005, p. 324; Spence, Helmreich & Pred, 1987, p. 525; Suls & Bunde, 2005, p. 292). In addition, athletes experience a wide range of environmental influences that could contribute to pain anxiety, such as ideologies around injury and removal from play.

Sex is a biological factor that is said to influence anxiety and pain, as is the psychosocial factor, gender. Females have been found to report more general anxiety, as well as more physical symptoms than males, (Armstrong & Khawaja, 2002, p. 13; Pennebaker, 1982, p. 139), and also demonstrate higher prevalence rates of general chronic pain conditions (Bingefors & Iverson, 2004, p. 438; Pennebaker, 1982, p. 139; Tsang et al., 2008, p. 887).

Given this wide range of factors that can influence fearful responses to pain, a comprehensive investigation into athlete pain anxiety is warranted.

CHAPTER 2: LITERATURE REVIEW

I) Psychological Processes of Pain and Pain Anxiety

In Beecher's (1959) book, *Measurement of Objective Responses,* he discusses observations of wounded soldiers returning from war (p. 164). The soldiers had demonstrated serious injuries, but despite this, reacted very little to the pain (p. 164). This behavioural phenomenon was attributed to a response of euphoria from finding safety (p. 164). It was observations like this that helped develop the idea that multiple, interconnected processes in the brain contribute to the experience of pain, and that there is a mind-body connection that influences the experience of pain (Melzack & Wall, 1965, p. 976). This was the basic premise behind Melzack and Wall's (1965) Gate Control Theory of Pain (p. 974).

The Gate Control Theory proposed that psychological processes influence pain. Such processes include both cognitive and emotional activity (Melzack & Wall, 1965, p. 976). For instance, when environmental stimuli demand attention over pain, individuals do not feel pain as intensely (Sprenger et al., 2012, p. 1019). Through the use of fMRI, Sprenger et al. (2012) demonstrated that when individuals allot attention to a working memory task during pain stimulation, pain ratings decrease, as does nociceptive activity in the spinal region (p. 1019). The authors discovered evidence to suggest that attentional modulation of pain is due to the release of endogenous opioids (p. 1020) that inhibit the experience of pain at the neuronal level (Budai & Fields, 1998, p. 677).

The endogenous opioid system provides an explanation of how psychological factors like attention can modulate pain. Endogenous opioids are a group of neurotransmitters found within the nervous system (Budai & Fields, 1998, p. 677) that inhibit arousal, negative emotion, and pain (Bruehl, Burns, Chung & Chont, 2011, p. 2). High concentrations of opioids exist within the periaqueductal gray region of the brain (Fields, 2000, p. 247), which controls pain transmission at the spinal cord site (Budai & Fields, 1998, p. 677). The periaqueductal gray receives neural input from the frontal lobe (Fields, 2000, p. 247), which is a region that facilitates cognitive processing. But attention is not the only psychological mechanism that can activate this system. Brain structures that give rise to emotion also contain opioids and pathways to the periaqueductal gray (Fields, 2000, p. 247), and pain has been found to be related to both emotional stress (Bair, Robinson, Katon & Kroenke, 2003, p. 2434; Bruehl et al., 2011, p. 10; Chieng et al., 2014, pp. 247-251; Denollet, 2005, p. 92; Ditre et al., 2013, p. 445; Hashizume et al, 2008, p. 4; McCracken et al., 1996, p. 929; McCracken et al., 1992, p. 70; Piñerua-Shuhaibar et al., 1999, p. 121; Sher, 2005, p. 324; Zhu et al., 2012, p. 117) and the retrieval of emotionally laden memories (Noel, Chambers, McGrath, Klein & Stewart, 2012, p. 1567).

Children's pain reports have shown to be altered by memories of pain. In a study by Noel, Chambers, McGrath, Klein and Stewart (2012), children between the ages of 8 and 12 underwent two testing trials with the Cold Pressor Task with the trials scheduled one month apart (p. 1565). During the trials, pain, fear, and anxiety reports were collected, and in the middle of the testing periods, children were contacted to recall memories of pain intensity and pain-related fear experienced in trial 1 (p. 1564-1565). Results indicate that children who rated the recalled pain from trial 1 as more intense than their pain intensity rating during trial 1 (i.e. negative memories of pain) were more likely to report higher levels of pain intensity and pain-related fear in the Cold Pressor Task in trial 2 (p. 1567). Furthermore, memories of pain-related fear also demonstrated a relationship to subsequent pain intensity ratings (p. 1567). These results suggest that memories of the pain experience, along with memories of the associated fear, can significantly influence the extent to which pain is felt.

According to Fields (2000), depression is a frequently studied construct within pain perception (p. 251). In a review of literature, Bair, Robinson, Katon & Kroenke (2003) found that an average of 65% of depression patients reported pain symptoms (p. 2434). Furthermore, experimentally induced pain is found to be more severe, and less tolerated by depressed individuals than controls (Piñerua-Shuhaibar et al., 1999, p. 121). Depression has also been linked to increased reports of somatization (Zhu et al., 2012, p. 117). Therefore, mood has an apparent influence on the pain experience.

Stress behaviour, such as that seen in the Type A and Type D personalities, is thought to give rise to poor health outcomes (Denollet, 2005, p. 92; Sher, 2005, p. 324). These personality types are characterized by anger, hostility, impatience, and over-reactivity, and have been identified as strong predictors of coronary heart disease and hypertension

(Denollet, 2005 pp. 89-92; Sher, 2005, p. 324). These personal characteristics have also been found to be associated with pain (Graham et al., 2006, p. 394). For instance, hostility was found to have a negative affect on pain outcomes and inflammation in older adults (Graham et al., 2006, p. 394). Furthermore, moods of irritability and daily hassles were found to precede episodes of headaches in migraine sufferers (Hashizume et al, 2008, p. 4).

Just as Sprenger et al. (2012) suggested that attention moderates pain through opioid release (p. 1021), Bruehl, Burns, Chung and Chont (2011) also provide evidence of opioids as a facilitative mechanism between anger and pain (p. 10). These authors found that chronic pain patients high in trait anger exhibited less endogenous opioid analgesia during acute anger experiences and had higher pain ratings than did individuals low in trait anger (p. 10). The authors concluded that individuals high in trait anger appear to lack the protective mechanism of opioid release during periods of anger, which leads to greater amplification of pain (p. 10). Seemingly, this impairment results from the chronicity of the anger (p. 10).

Chieng, Chan, Klainin-Yobas and He's (2014) meta-analysis investigated the relationship between anxiety and pain in children and adolescents requiring medical surgery (p. 244). Across the studies, participants ranged in age from 5 to 18 and underwent a wide range of medical operations (p. 246). Chieng et al. (2014) concluded that a relationship indeed exists between perioperative anxiety and postoperative pain (p. 251). Results demonstrated a clear and consistent pattern between anxiety and pain in children and adolescents, and not just in pain intensity ratings, but in recovery ratings as well (pp. 247-251).

More specifically, pain-related anxiety can have significant influences on the pain experience. Pain anxiety within adult cohorts has been linked to increases in pain intensity (Ditre et al., 2013, p. 445; McCracken et al., 1996, p. 929; McCracken et al., 1992, p. 70). Induced pain anxiety in both animal and human subjects has also been found to increase pain intensity (Rhudy & Meager, 2000, p. 68-71). The effect of pain anxiety on the pain experience may be even stronger than the effects of general anxiety. As Quevedo and Coghill's (2007) work demonstrates, when attentional resources are devoted towards pain, as in the case of a highly pain-anxious individual, pain becomes amplified (p. 11636).

Chronic pain populations have been found to differ from healthy populations in psychological characteristics. This creates a vulnerability to developing pain anxiety. Specifically, individuals with chronic pain are more likely to have psychopathologies (Dersh, Polatin & Gatchel, 2002, pp. 776-783). Polatin, Kinnedy, Gatchel, Lillo and Mayer (1993) found 77% of chronic lower back pain patients met the criteria for a psychological disorder (p. 67). This characteristic could create differences in how a chronic pain group responds to pain compared to a healthy population.

Two of the most prevalent disorders in chronic pain include depression and anxiety (Dersh et al., 2002, p. 783). Canadians with chronic pain have been found to have higher rates of depression than those who are pain-free (19.8% versus 5.9%) (Currie & Wang, 2004, p. 57). Many of the characteristics of depression, such as catastrophizing and somatic complaints, could increase the likelihood of experiencing anxiety towards pain (Carleton et al., 2009, p. 795; Turner & Aaron as cited in Sullivan, 2009, p. 9; Vlaeyen et al, 1995a, p. 238; Vlaeyen & Linton, 2000, p. 319). Furthermore, 25% of chronic pain patients have been found to exhibit clinical anxiety in the form of panic disorder, agoraphobia, specific phobia, social phobia, generalized anxiety disorder, obsessive compulsive disorder, and posttraumatic stress (Knaster, Karlsson, Estlander & Kalso, 2011, p. 48). This suggests chronic pain patients may be more likely than the general population to experience anxiety, which may increase the likelihood of developing pain anxiety.

In addition, chronic pain patients may also be more susceptible to pain anxiety because of a need to take caution in relation to pain and injury. For instance, an injury occurrence in a pain-free individual may not have as strong of a relationship to pain anxiety compared to an individual with chronic pain, as an injury could exacerbate the chronic pain condition. Vlaeyen et al. (1995a) propose that both a fear of pain and injury are two common characteristics of chronic pain patients (pp. 238-239), and Huijnen, Verbunt, Peters and Seleen (2010) demonstrated that chronic back pain patients, with a fear of pain, often limit physical movement (p. 665).

Pain anxiety may not only differ across chronic pain and the general population, but also across gender. Interestingly, various forms of anxiety have been found to be more common in females than males, which may have profound effects on the pain experience between genders (Armstrong & Khawaja, 2002, p. 16; McLean, Asnaani, Litz & Hofmann, 2011, p. 6). Armstrong and Khawaja (2002) examined gender differences in reports of anxiety symptoms in a non-clinical sample of university students (p. 8). Results indicated that women experienced a higher severity of general anxiety than men (pp. 12-15). Specifically, women scored higher on the cognitive measures of this anxiety, which included measures of fear and catastrophizing towards cognitive, emotional, and physical symptoms of anxiety (pp. 12-15). However, there were no differences found between men and women on sensitivity toward psychosocial and physical consequences of anxiety (p. 13-15). The authors concluded that women in a non-clinical population experience more anxiety than men, primarily, on a cognitive level (p. 16).

Clinical anxiety has also been found to manifest more strongly in women than in men. An epidemiological study examined adult anxiety disorders across genders (McLean et al., 2011, p. 3). McLean, Asnaani, Litz and Hofmann (2011) found higher prevalence rates of each DSM-IV anxiety disorder in women than in men, with the exception of Social Anxiety Disorder, which showed similar rates between genders (pp. 5-6). These findings resulted even after controlling for demographic differences (p. 6). Anxiety was also found to be more chronic in women than in men. The chances of experiencing an anxiety disorder within the year prior to testing were significantly greater for women that had an anxiety disorder at some point within her lifetime than for men with a lifetime incidence of anxiety disorder (p. 6).

This gender discrepancy in anxiety may contribute to why women report higher rates of pain than men. As demonstrated by previous research, anxiety can increase pain severity (Chieng et al., 2014, p. 251; McCracken et al., 1996, p. 929; McCracken et al., 1992, p. 70), which may actually worsen pain experiences for females. However, a meta-analysis on anxiety and pain perception between genders concluded that the influence of women's anxiety on pain is uncertain (Jones & Zachariae, 2002, p. 94). In addition, more recent research shows that anxiety affects pain intensity in men but not in women (Thibodeau, Welch, Katz & Asmundson, 2013, pp. 423-424). A noteworthy finding in the study, however, was that anxiety did influence pain tolerance in women but not in men, suggesting that the mechanism connecting anxiety to pain differs between genders (Thibodeau et al., 2013, pp. 423-425). It may be that anxiety affects women's pain differently from men's by triggering more emotional responses. Women demonstrate greater neural processing of emotions in response to arousing stimuli, facial expressions, and emotional memory than do men (Hamann & Canli, 2004, p. 234), which may also be the case in pain.

Another explanation for why women demonstrate higher rates of pain than men could be attributed to sex hormones. The fluctuations in estrogen that occur throughout a woman's menstrual cycles are said to influence pain sensitivity (Cairns & Gazerani, 2009, p. 294). For instance, it appears as though rapid changes in estrogen levels are responsible for greater musculoskeletal pain (p. 294). Cairns and Gazerani (2009) identify opioids as the mechanism of action (p.294). Low levels of testosterone also appear to affect opioid activity (pp. 294-295). Wiesenfeld-Hallin (2005) states that gonadal hormones, like testosterone, have close neural connections to opioid receptors within the nervous system (p. 141). Both opioids and testosterone can modulate one another (p. 141), and depending on the levels of the hormone, can either increase or decrease pain (Cairns & Gazerani, 2009, p. 294).

II) Fear and Anxiety

Fear and anxiety are unpleasant emotional phenomena that are elicited by perceived threat for the purpose of escaping and avoiding harm (Steimer, 2002, pp. 232-234). They are a "product of natural selection," as they have acted as survival tools for our ancestors (Öhman, 2008, p. 710). For instance, fear and anxiety initiate similar physiological responses, such as a rapid heartbeat and muscle tension, to facilitate the fight-or-flight response (Öhman, 2008, p. 710). They also trigger similar sensory responses, such as a heightened perception, to better equip the individual to cope with threat (Barlow, 2004, p. 3; Pappens et al., 2013, p. 226). Thus, fear and anxiety are not only adaptive, but also necessary.

However, fear and anxiety can manifest in ways that are likely to be harmful to physical or psychological well-being. Such maladaptive responses are typically said to occur when the response intensity is not proportional to the objective level of danger (Öhman, 2008, p. 710). More specifically, this is known as irrational fear or irrational anxiety (Zimmerman, Dalrymple, Chelminski, Young & Galione, 2010, p. 1045). This can be seen in cases of phobias, when individuals experience a debilitating fear of stimuli with low threat-value, such as in social phobias (Bögels et al., 2010, p. 182). Overestimates of fear are found in anxiety disorders, obsessive-compulsive disorders, and trauma and stressor-related disorders (American Psychiatric Association & American Psychiatric Association 2013, pp. 5-9). These responses can lead to further distress in the individual and severely limit quality of life. On the other hand, underestimates of fear are a feature of antisocial personality disorder (Birbaumer et al., 2005, p. 805). Irrational fear in this case may consist of an absence of fear when engaging in criminal behaviour. Responses of this nature increase the likelihood of risk-taking behaviour, which puts both the individual and society at risk.

Within the literature on fear and anxiety, there exists a clear difference between adaptive and maladaptive responses. However, the distinguishing features between fear and anxiety are not as evident. As Steimer (2008) states, many authors use the terms interchangeably while others view them as unique (p. 233). Nonetheless, there have been many efforts to disentangle the two constructs.

One difference that is often cited is the presence of the threat (Öhman, 2008, p. 710; Rhudy & Meager, 2000, p. 65). Fear is typically defined as a perceived threat that is present, while anxiety is defined as a perceived threat that is future-oriented (Öhman, 2008, p. 710; Rhudy & Meager, 2000, p. 65). For instance, feeling threatened by a vicious bear in the woods would classify as fear. On the other hand, feeling threatened by the possibility of running into the bear in the future would classify as anxiety. Öhman

(2008) elucidates this difference by explaining that "fear occurs post-stimulus, while anxiety occurs pre-stimulus" (p. 710).

Another noted difference is in the function (Asmundson, Norton & Vlaeyen, 2004, pp.12-13; Leeuw et al., 2007, p. 78). In Asmundson, Norton and Vlaeyen's (2004) revised Fear-Avoidance Model (FAM) of chronic musculoskeletal pain, fear is described as a motivator for defending against harm (escape), whereas anxiety is described as a coping method for preventing harm (avoidance) (pp. 12-13). Leeuw et al. (2007) noted in their critique on the model that avoidance cannot be a function of fear because one cannot avoid a stressor that is already present (p. 78). This notion is clear when considering fear's fight-flight-freeze response (Hagenaars, Oitzel & Roelofs, 2014, p. 173). It is proposed that a presently experienced stressor elicits a fear response that will enable the organism to eliminate or escape from immediate harm (Barlow, 2004, p. 3; Whishaw & Dringenberg, 1991, p. 254). Specifically, the organism will be driven to fight against the threat, flee from the threat, or remain still (Barlow, 2004, p. 3; Whishaw & Dringenberg, 1991, p. 254). Each of these responses classify as escapism as they strive towards escaping the threat. Contrastingly, anxiety elicits a preventive response (Asmundson et al., 2004, p. 13). The future-oriented nature of the threat requires planning, strategy, and assessment in order to prevent harm (Barlow, 2004, p. 1).

A third notable difference is in the generation of cognitive processes (Borkovec & Newman, 1998, p. 439; Leeuw et al., 2007, p. 78; Öhman, 2008, p. 713). Being future-oriented, anxiety is the foundation of worry, which has been described as generated thought used to avoid potential negative outcomes in future events (Borkovec & Newman, 1998, p. 439). Furthermore, hypervigilance has been said to accompany anxiety rather than fear (Leeuw et al, 2007, p. 78; Öhman, 2008, p. 713). Hypervigilance involves devoting excessive attention towards a threat, and monitoring or scanning the environment for potential signs of harm (Barlow, 2004, p. 94). Öhman (2008) proposes that hypervigilance acts as the control system following fear, while enabling continuous analysis for the purpose of developing strategies in the case of encountering new threats (p. 713).

Ultimately, fear and anxiety share similar features yet some differences between the constructs can be described. Both are emotions, triggered by perceived threat, and aiding in maintaining survival (Öhman, 2008, p. 710; Steimer, 2002, pp. 232-234). Fear and anxiety also trigger similar physiological and sensory systems in the body (Barlow, 2004, p. 3; Öhman, 2008, p. 710; Pappens et al., 2013, p. 226). In contrast, fear and anxiety have differing threat characteristics (Öhman, 2008, p. 710; Rhudy & Meager, 2000, p. 65), differing functions (Asmundson, Norton & Vlaeyen, 2004, pp.12-13; Leeuw et al., 2007, p. 78), and differing cognitive responses (Borkovec & Newman, 1998, p. 439; Leeuw et al., 2007, p. 78; Öhman, 2008, p. 713). In the present study, the terms are defined as follows: *Fear* as a perceived threat that is present-oriented and facilitates escape, and *anxiety* as a perceived threat that is future-oriented, facilitates avoidance, and can initiate cognitive responses of worry and hypervigilance (Asmundson, Norton & Vlaeyen, 2004, pp. 11-13; Borkovec & Newman, 1998, p. 439; Leeuw et al., 2007, p. 78; Öhman, 2008, pp. 710-713; Rhudy & Meager, 2000, p. 65; Steimer, 2002, pp. 232-234).

III) A Theoretical Perspective on Fear and Anxiety in Pain: The Fear-Avoidance Model of Chronic Musculoskeletal Pain

I) The Development of Fear and Anxiety in Pain

There is a need for a deeper understanding of why individuals exhibit differences in levels of fear and anxiety toward pain (Carleton et al, 2009, pp. 791-792). While Letham, Slade, Troup and Bentley's (1983) FAM pertains to musculoskeletal pain (p. 405), it has been applied to various forms of pain, and nonetheless, offers insight into understanding how fear and anxiety can emerge in response to pain (Sgroi, Willebrand, Ekselius, Gerdin & Andersson, 2005, p. 492; Thomtén & Karlsson, 2014, p. 194). The FAM highlights two important precursors to pain-related fear and anxiety: pain intensity and negative appraisals.

i) Pain Intensity

According to earlier versions of the FAM, the severity of pain was thought to have no effect on fearful responses in pain (Leeuw et al., 2007, p. 79). However, the model has since adjusted for pain intensity by identifying it as an important contributor to a fear of pain and pain anxiety (p. 79). The FAM acknowledges that the intensity of the pain stimulus has inherent threatening properties that drive escape and avoidance behaviors (Eccleston & Crombez, 1999, p. 362). Accordingly, individuals appear to deem pain as more threatening as its intensity rises, which is likely because of the significant meaning pain holds in relation to his or her physical health.

Results from studies on pain and attention indicate potential for a relationship between pain intensity and attentional components of pain anxiety. It has been repeatedly shown that individuals experience more distraction during attention-based tasks when exposed to higher intensities of pain, suggesting that intense pain stimuli require a great deal of attention (Eccleston & Crombez, 1999, p. 358). Thus, the severity of pain could be a facilitator of hypervigilance and preoccupation with pain.

Moreover, Crombez, Viane, Eccleston, Devulder and Goubert's (2013) findings add support to this evidence (p. 375). Pain intensity was studied in a group of chronic pain patients by asking participants to report on various psychological variables during various episodes of pain (p. 373). Results indicated that as pain intensity increased, patients reported devoting more attention towards the pain sensations (p. 374). It was also found that higher levels of pain intensity involved more fearful thoughts about pain (p. 374). Taken together, these empirical findings support the notion that pain intensity plays a role in the development of fear and anxiety toward pain.

ii) Negative Appraisals

The FAM proposes that negative appraisals, or negative judgments, contribute to fear and anxiety in pain (Vlaeyen & Linton, 2000, p. 320). This notion is supported by earlier work of Watson and Pennebaker (1989) who suggest that individuals who are prone to negative appraisals are hypervigilant towards all forms of threat including threats to health, even in the absence of health conditions (pp. 244-247). The FAM identifies four psychological constructs that are constituted by negative appraisals and give rise to fear and anxiety in pain: fear-avoidance beliefs, catastrophizing, anxiety sensitivity, and fear of (re)injury.

Fear-avoidance beliefs are defined as misconceptions of the threat of pain from physical movement (Vlaeyen et al., 1995a, p. 239; Vlaeyen & Linton, 2000, p. 327). These beliefs can stem from threatening information pertaining to health and illness (Leeuw et al., 2007, p. 79), consequently increasing pain's threat-value. Fear-avoidance beliefs can also be transmitted from parent to child through observational learning (Goubert, Vlaeyen, Crombez & Craig, 2011, p. 169). In addition, fear-avoidance beliefs can develop from psychological trauma (Vlaeyen & Linton, 2000, p. 327). Chronic pain patients with post-traumatic stress symptoms have been found to report higher levels of fear-avoidance beliefs (Ruiz-Parraga & Lopez-Martinez, 2014, p. 965).

Catastrophizing is a particular style of thinking characterized by rumination (dwelling), magnification (exaggeration of negative outcomes), and helplessness (Sullivan, 2009, p. 4). This construct has been shown to be closely associated with fear and distress in pain (Goubert, Crombez & Van Damme, 2004, p. 239; McWilliams & Asmundson, 2007, p. 30). Pain catastrophizing, in particular, correlates strongly to pain anxiety (Kadimpati, Zale, Hooten, Ditre & Warner, 2015, p. 4). Individuals who report high levels of anxiety and depression, which are two disorders with catastrophizing tendencies (Garnefski, Legerstee, Kraaij, Kommer & Teerds, 2002, p. 607), also report high levels of pain-related fear (Carleton et al., 2009, p. 793).

Anxiety sensitivity is a fear of the somatic sensations involved in the fear and anxiety responses and is said to lead to a fear of pain (Reiss, Peterson, Gursky & McNally, 1986, p. 2). A noteworthy theory on this causation proposes that the fear of somatic sensations becomes more specific and leads to a fear of pain (p. 7). Other theorists also support this notion of an increase in fear specificity, suggesting that anxiety sensitivity is the foundation to a fear of pain (Asmundson, Norton, & Norton, 1999, p. 109; Vlaeyen & Linton, 2000, p. 320). More recent research suggests this may be the case, as individuals with anxiety sensitivity also tend to fear illness and injury (Vancleef, Peters, Roelufs & Asmundson, 2006, p. 534).

The FAM highlights the importance of *fear of (re)injury* in facilitating pain-related fear (Vlaeyen et al., 1995b, p. 364; Vlaeyen & Linton, 2000, p. 318; Vlaeyen et al., 1995a, p. 239). It is described as a fear of movement that is wrongfully presumed to cause injury (Vlaeyen et al., 1995a, p. 239). This fear of injury is suggested to underlie a fear of pain (Vlaeyen & Linton, 2000, p. 318). Vlaeyen et al. (1995b) clarify this, by proposing that fear can extend towards neutral stimuli that are associated with the feared stimulus (p. 364). Vlaeyen and Linton (2000) describe this process as a classical conditioning process that often occurs in chronic pain cases (p. 318). Studies have shown that this may be the case, as fear of (re)injury is closely linked to avoidance responses of pain-eliciting activities (Vlaeyen et al., 1995b, p. 369). In fact, Kori, Miller and Todd originally defined fear of (re)injury as a consequence of feeling vulnerable towards pain (as cited by Vlaeyen et al., 1995a, p. 240).

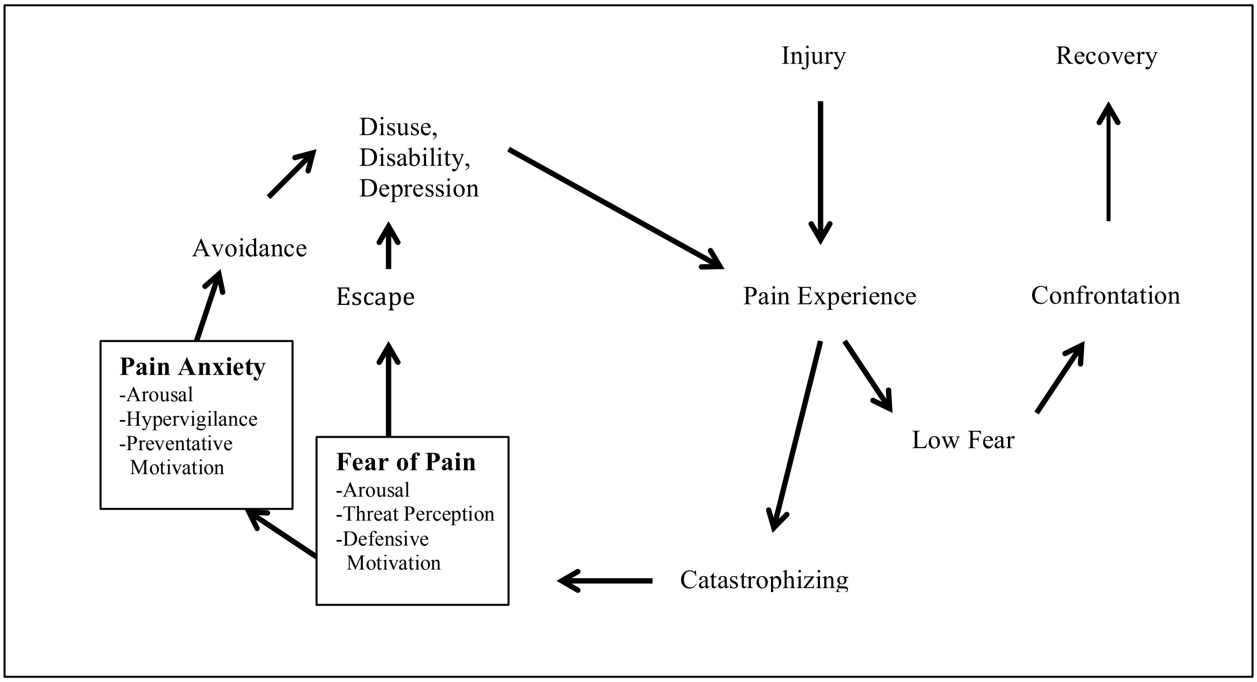

Figure 1. The Fear Avoidance Model of Chronic Musculoskeletal Pain.
An outline of the cycle of chronic musculoskeletal pain. Adapted from: Leeuw et al.'s (2007) adapted version from Vlaeyen & Linton (2000) and Asmundson et al., (2004) (p. 79).

II) The Continuity of Fear and Anxiety in Pain

The FAM illustrates how fear and anxiety in pain is maintained (see Figure 1) (Asmundson et al., 2004, p. 15; Leeuw et al., p. 79). Escape-avoidance responses are highlighted as primary contributors to the continuation of fear and anxiety, and identify escape-avoidance responses as significant predictors of chronic pain conditions (Vlaeyen & Linton, 2000, p. 317). The consequences of escape-avoidance, which include deconditioning and depression, are additional factors that are said to play a role in perpetuating the cycle (pp. 319-329). The underlying premise of the FAM is that confrontation of pain will discontinue the cycle of fear, anxiety, and pain (p. 329).

i) Escapism and Avoidance

Escapism is known as the act of defensive responses stemming from fear in the presence of pain (Asmundson et al., 2004, p. 12). Avoidance, on the other hand, is the preventative responses stemming from anxiety in the anticipation of pain (p. 13). Both escape and avoidance provide a sense of safety for the individual (Leeuw et al., 2007, p. 78). Fearful and anxious chronic pain patients demonstrate these responses when faced with a physical task that either elicits pain or is thought to elicit pain (Vlaeyen et al., 1995b, p. 369; Vlaeyen, de Jong, Geilen, Heuts & van Breukelen, 2002, p. 252). These patients also demonstrate guarded movements by restricting muscle movements when performing physical activities such as walking, which is an obvious sign of escape-avoidance (Leeuw et al., 2007, p. 81).

Vlaeyen et al. (1995a) state that although avoidance of pain is necessary for well-being, it is only essential when responding to the presence of acute pain (p. 238). More specifically, it is explained that avoidance becomes maladaptive when, for instance, the individual begins to continuously limp or rest in anticipation of the pain rather than in response to the pain itself (p. 238). However, the maladaptive nature of this particular avoidance response may only hold true when there is no underlying injury or pathology. That is, in cases without a biological pathology, continuous avoidance could be seen as excessive, indicating a maladaptive response. In contrast, persistent avoidance during an injury recovery of long-duration would help prevent aggravation of the injury, indicating an adaptive response. With this said, the context of pain avoidance is important to consider when determining appropriate levels of pain anxiety. Nonetheless, the theory behind the FAM posits that continuous avoidance behaviour maintains a fear of pain.

It is said that escapism and avoidance deprive the individual of the pain experience, which actually perpetuates the fear and anxiety (Vlaeyen & Linton, 2000, p. 319). According to this notion, not facing the pain prevents opportunities to develop more positive appraisals of the pain, which likely maintains the negative appraisals that lead to fear and anxiety. Furthermore, the opportunity to disconfirm mistaken beliefs about pain is also missed (p. 319). As a result, fear-avoidance beliefs remain intact and the fear, anxiety, and pain persist.

ii) Deconditioning

The FAM proposes that continuous escape and avoidance of pain leads to sedentary behavior, initiating a deterioration of overall health described as deconditioning (Vlaeyen & Linton, 2000, pp. 323-324). Abstaining from physical activity deconditions the body, producing what is known as disuse syndrome (Verbunt et al., 2003, pp. 9-10). A number of symptoms result, including weakness, fatigue, cardiovascular disturbances, and respiratory issues (p. 10). It is claimed that such deconditioning produces a physically deteriorated state of the muscles that worsens pain, and as a consequence of heightened pain, the fear and avoidance continue (Vlaeyen et al., 1995b, p. 369).

It is also possible that deconditioning maintains a fear of pain by preventing the efficacy of therapeutic interventions for maladaptive pain anxiety. Aerobic exercise is said to activate neurotrophins, which strengthen neural functioning and brain plasticity (Cotman

& Berchtold, 2002, p. 295). Common therapies used to treat patients with a fear of pain rely on this plasticity to rewire maladaptive neural connections through facilitating changes at the cognitive and behavioural levels (McEwen, 2012, p. 17183). Thus, a limited capacity for plasticity can prevent the development of healthy pain-related behaviour.

iii) Depression

Vlaeyen and Linton (2000) note that chronic escape-avoidance behaviour creates the conditions for mood disturbances and depression (p. 319). That is, when physical activities are avoided, the individual suffers a loss of self-esteem, withdrawals from social encounters, and misses out on positive reinforcers (Vlaeyen et al, 1995a, p. 238; Vlaeyen & Linton, 2000, p. 319). It is proposed that the resulting depression depletes motivation, which leads to further avoidance responses (Roshanaei-Moghaddam, Katon & Russo, 2009, p. 306; Vlaeyen & Linton, 2000, p. 319). Depression is also thought to maintain the cycle of fear, pain, and avoidance through its association with hypervigilance, causing preoccupation with somatic sensations (Vlaeyen et al., 1995a, p. 238). Zhu et al. (2012) found somatization to be a key feature of depression (p. 117). Moreover, depression demonstrates an association with catastrophizing (Sullivan, 2009, p. 9), which has strong connections to pain-related fear and anxiety (Goubert et al., 2004, p. 239; McWilliams & Asmundson, 2007, p. 30). There is also a strong co-morbidity with depressive and anxiety disorders that may create vulnerabilities in developing a fear of pain. Approximately 50-90% of individuals with a mood disorder also receive a diagnosis of an anxiety disorder (Soehner & Harvey, 2012, p. 1367).

IV) Athletes and Pain

Athletic participation increases the likelihood of experiencing pain due to the risk of injury (Kujala, Taimela &Viljanan, 1999, p. 327). According to Jacobsson et al. (2013), 68% of elite athletes sustain either an overuse or traumatic injury over a single playing season (p. 943). There is some evidence that even suggests athletes' have higher prevalence rates of pain than non-athletes. Compared to controls, athletes have demonstrated higher rates of both acute and chronic forms of pain in the thoraco-lumbar, knee, foot, and ankle regions (Jonasson et al., 2011, p. 1542; Kim, Chung & Lee, 2013, p. 1271).

Given that pain is often a part of an athlete's experience, the ability to cope with pain becomes crucial. Stereotypically, athletes are perceived to be stoic in response to pain (Nixon, 1993, p. 183; Safai, 2003, p. 128). If this is the case, this could be seen as maladaptive coping. Stoicism can lead to negative health outcomes if the athlete is truly injured, such as further injury to the body. However, whether athletes respond to pain in this manner remains to be shown.

I) Pain Behaviour

An important influence on behaviour is identity, and therefore, has an important role in determining responses to pain. Identity consists of our values, beliefs, attitudes, and roles, which each determine how we act and behave in society (LaGuardia, 2009, pp. 91-92). Athlete identity is becoming more prominent in the research. Brewer, Van Raalte and Linder conceptualize athlete identity as the extent to which a person identifies with an athlete role (Brewer, Van Raalte & Linder, 1993, p. 237). Given that individuals are inclined to act in accordance with their sense of identity (LaGuardia, 2009, p. 93), this may have important implications for how athletes cope with pain.

One particular expectation that contributes to the athletic role is the ability to respond stoically to pain. Nixon (1992) elaborates by discussing the pressures athletes face to play through pain and injury (pp. 186-188). In this overview, reference is given to Hughes, Coakley, Yiannakis, and Melnick (1991) who state that athletes are embedded in a culture of risk, making them more willing to uncritically accept the risks of such behaviour (p. 308). An example of this culture includes the ostracism athletes experience from teammates in expressing symptoms of illness or injury (Waldron & Krane, 2005, p. 324). However, Safai (2003) says that the responsibility of the culture's continuation is not exclusive to athletes (p. 128).

Physicians within competitive sport are said to contribute to this culture of risk, as many medical personnel are associated with team management, and thus experience pressure to play an injured athlete or expedite recovery (Safai, 2003, pp. 130-131). As well, evidence demonstrates that athletes experience pressure to endure pain to impress important members of an audience (Pike & Maguire, 2003, p. 239), the media (Nixon, 1993, p. 187), and in many cases, to simply maintain a scholarship or a paycheck (Nixon, 1993, p. 186; O'Connell, 2012, p. 17). Weinberg, Vernau and Horn (2013) note that a significant source of the pressure stems from coaches. According to many coaches, athletes who play through injury deserve the most respect (Weinberg et al., 2013, p. 43).

Such pressures present serious concerns for the safety of athletes and athlete pain behaviour.

However, this potential for harm does not eliminate the possibility that this culture may, in some way, better equip athletes to cope with pain. For instance, a common norm seen among athletes is to remain tough during pain and "take one for the team" (Stadden, 2007, p. 9). Many athletes will sacrifice their own well-being for the sake of others' approval or praise (Pike & Maguire, 2003, p. 239). This outcome may provide them with a sense that something good is to come from the pain. Knowing that pain will result in a positive outcome has the potential to reduce both the psychological and physical suffering in pain (Arntz & Claassens, 2004, p. 20). This is not to say that playing through pain is beneficial to the athlete, as this increases risk of injury. Rather, the point is that athletes may be able to endure high-levels of pain because they find meaning in their suffering.

It is evident that athletes experience pressure to endure pain. Nixon (1992) highlights the potential impact this can have on athletes (p. 188). In particular, when athletes become embedded by such a culture, risk, injury, and pain begin to normalize (p. 188). This creates concern for the long-term health outcomes of athletes and emphasizes the importance in understanding social influences in athlete pain.

II) Pain Tolerance

A systematic review has demonstrated that athletes have a higher pain tolerance compared to non-athletes (Tesarz, Schuster, Hartmann, Gerhardt & Eich, 2012, p. 1256).

This analysis was performed with 15 studies that examined the outcomes of pain tolerance and pain threshold in both athletes and controls (p. 1254). Standardized mean differences between athletes and non-athletes were calculated for the outcome measures (p. 1254). Effect sizes were also calculated to test for statistical differences (p. 1255). Through analyzing the high-quality studies, a moderate to strong effect size was found for pain tolerance, indicating a higher pain tolerance among athletes than controls (p. 1256). Significant differences in pain threshold were evident but not as consistent (pp. 1255-1256).

A proposed explanation for these findings is that athletes are required to develop pain coping strategies that are effective in managing pain because of the frequent demand to withstand pain during competition and intense training (p. 1256-1259). However, there is no certainty of whether a relationship exists between athlete pain tolerance and athlete pain coping. Thus, we should not assume a high tolerance is indicative of an adaptive coping response. Coping strategies can be successful in facilitating tolerance to a stressor but this does not ensure that such strategies are beneficial to the athlete. For instance, 71% of former professional football players who used medication to play through pain reported substance abuse (King et al., 2014, p. 250). Although overmedicating may have supported the athletes' abilities to tolerate the pain, this coping method may have jeopardized their health and performance abilities. It is clear that psychological responses to pain are influenced by factors other than pain tolerance.

An alternative explanation to the findings in athlete pain tolerance is that athletes become desensitized to pain on account of frequent exposure to pain and physical sensations (Raudenbush et al., 2012, p. 93). Using a Cold Pressor Test, Raudenbush et al. (2012) provided evidence for this by showing that male athletes from contact sports demonstrated higher pain tolerance and lower pain severity reports than male athletes who did not have experience with contact sport (pp. 88-89). They provided further evidence by finding that a history of injury and pain was significantly related to a higher willingness to play through pain (p. 91). This supports the idea that athletes' experience with pain can produce a desensitizing effect.

A clear issue with the desensitization claim is that habituation depends on the intensity level of the stimulus (Mazur, 2006, p. 50). Habituation has been identified as a facilitative component of the desensitization process (Siniaia, Young & Poon, 2000, p. 479). A habituated response is shown when a stimulus initially elicits a stronger response, but then after repeated exposure, the reaction weakens (Walker, 1976, p. 13). According to general principles of habituation, a habituated response will only occur with minor pain, not with pain of higher intensity levels (Mazur, 2006, p. 50). Von Dincklage, Olbrich, Baars and Rehberg (2013) demonstrated the influence of stimulus intensity on degrees of habituation to pain by measuring the nociceptive flexion reflex after repeated stimulation (p. 849). Habituation was found to be stronger with low intensity stimulation and weaker with high-intensity stimulation (p. 849). Therefore, because athletes experience pain of various intensities, repeated exposure to pain does not guarantee desensitization will occur.

Finally, a major issue to consider with the pain tolerance studies is that pain tolerance was determined through the use of artificially induced pain stimuli. As a consequence, the research participants know that the stimulus, while perceived to be a discomfort, will not pose life-threatening consequences. Similarly, the athlete does not perceive these stimuli to cause irreparable damage or injury. Furthermore, study participants know the source of the stimulus, and according to Gamble (1994), the participant would perceive a sense of safety (p. 68), thereby reducing the threat-value of the pain. In a natural setting, the threat-value of pain will likely increase due to the uncertain characteristics of the pain and the potential for harm. Therefore, while it may be true that athletes respond well to pain in an experimental setting where threat-appraisals are strictly controlled by the researcher, athletes may not cope as well with pain that occurs during actual sport performance.

In interpreting the research into pain tolerance of athletes, it is clear that while they demonstrate a higher pain tolerance than non-athlete cohorts, this is not indicative of coping ability. More specifically, pain tolerance is just one mechanism behind pain coping; other factors contribute to this process. In addition, high pain tolerance in athletes cannot be entirely attributed to desensitization, as the strength of habituation depends on the intensity of the pain (Walker, 1976, pp. 13-18; von Dincklage et al., 2013, p. 849). Lastly, the context of pain must be taken into consideration when examining pain tolerance. There may be significant discrepancies in psychological responses to pain experienced in experimental settings versus daily life.

III) Pain Coping

Studies on athlete pain coping demonstrate mixed results. According to Bardel, Woodman, Perreaut-Pierre and Barizien (2013), athletes can experience high anxiety in relation to pain (p. 579). The researchers administered the Pain Anxiety Symptoms Scale-40 (PASS-40) to a group of male rugby players (ages 17-26, N=58) who reported to be without injury at the time of testing (pp. 576-577). The PASS-40 assesses individual responses to pain-related statements through prompting reflection of past pain experiences (McCracken, Zayfert & Gross, 1992, p. 69). The authors found that rugby players exhibited high levels of pain anxiety (p. 578). These results were attributed to an attentional bias to pain-related stimuli (p. 579).

In comparison, Johnson, Stewart, Humphries & Chamove (2011) examined pain responses in marathon runners (p. 768) and found that these athletes coped no differently with pain than non-athletes (pp. 770-772). Both the runners and the control group were in good health, and as part of the experiment, completed coping-related self-reports and underwent a pain-stimulating task via potassium iontophoresis (pp. 768). No significant differences were found between the athletes and controls on the use of coping strategies or catastrophizing (p. 773). In fact, it was determined that the marathon runners had higher levels of pain-specific self-efficacy than the controls (p. 772).

One explanation for these contrasting results is that Bardel et al.'s study did not screen for medical conditions unlike Johnson et al.'s. While the rugby players were injury-free (Bardel et al., 2013, pp. 576-577), it is possible that these athletes experienced non-injury related chronic pain, such as chronic headaches. This would explain why the reports of high pain anxiety were seen in the rugby players, as anxiety has close ties to chronic pain (Kroenke et al., 2013, p. 361). Another explanation for these results may also be attributed to the participants' genders and sport types. Specifically, the rugby players consisted of all males while the group of marathon runners was mixed. The rugby players were also involved in a more dangerous sport compared to the runners. Both of these variables increase the likelihood of injury. That is, males are more likely to be aggressive (Archer, 2004, p. 311) and rugby is an aggressive sport in itself. Therefore, the male rugby players may have been more distressed by pain than the runners due to a higher risk of injury.

Inconsistent results are also found within two studies that used the same assessment tool to examine pain appraisals in athletes (Anderson & Hanrahan, 2008, pp. 12-13; McDowell & LaChapelle, 2005, p. 30). In particular, McDowell and LaChapelle (2005) found varsity athletes (39 males and 41 females) who reported various forms of pain used more adaptive coping strategies in relation to their pain experiences in comparison to the general population (pp. 24-30). Specifically, approximately 53% of athletes perceived pain as a challenge and only 19% perceived it as a threat (p. 30). In a later study, however, Anderson and Hanrahan (2008) also examined pain appraisals in athletes with varying types of pain but within a cohort of professional dancers (17 males and 34 females) (p. 11). Their results demonstrated that the dancers scored higher on the threat appraisals of pain than on the challenge appraisals of pain (p. 12-13).

These results as shown by McDowell and LaChapelle versus Anderson and Hanrahan, could be a result of personality differences. Eusanio, Thomson and Jaque (2014) found male and female dancers to exhibit more perfectionism than non-dancers (p. 109) and perfectionism is closely associated with psychological stress (Chang & Rand, 2000, p. 142). In particular, perfectionism was found to predict high levels of depression, anxiety, hostility, and hopelessness in college students (Chang & Rand, 2000, p. 142). Thus, perfectionistic tendencies may explain the high threat appraisals in professional dancers.

Athletes' responses to pain may also be influenced by the consequences of injury in sport. Research shows male injured athletes are vulnerable to emotional stress following injury, which may be due to time away from sport (Leddy, Lambert & Ogles, 1994, p. 351). Further, Udry, Gould, Bridges and Beck (1997) highlighted return to play as a concern following athletic injury in both males and females (p. 235). In their qualitative analysis of injured skiers (11 males and 10 females), nearly half of the athletes struggled with the negative impact the injury was going to have on sport involvement (p. 235). This lost time following an injury may influence the athlete's pain coping responses in that the athlete will be eager to recover, and as a result, develop aversion toward the pain.

Cartoni, Minganti and Zelli (2005) report that even healthy athletes, male and female, experience fears of injury, suggesting that uninjured athletes may also experience this anxiety over lost time when considering the potential for an injury occurrence (pp. 6-9). If this is the case, uninjured athletes may be more hypervigilant towards signs of pain. One factor that may be influential in this anxiety is the time of season for the athlete.

Cresswell and Ekland's (2007) research suggests that athletes experience changes in stress across pre, mid, and postseason, and that preseason training requires substantial mental preparation on the part of the athlete (p. 15). This stress could create a vulnerability to anxiety. Furthermore, injury anxiety and pain anxiety may be more prevalent as athletes approach the beginning of a new season, as an injury occurrence at this time could put an athlete out for rest of the playing season.

As a conclusion of the presented research into athlete pain coping, there needs to be an inclusion of a variety of factors if researchers are to accurately investigate athletes' coping responses with pain. Findings show that there may be a need to take the following factors into consideration when examining coping: chronic pain conditions, gender, sport type, risk of injury (Bardel et al., 2013, pp. 576-579; Johnson et al., 2011, pp. 768-773), vulnerabilities to stress appraisals (Anderson & Hanrahan, 2008, pp. 12-13; Chang & Rand, 2000, p. 142; Eusanio et al., 2014, p. 109; McDowell & LaChapelle, 2005, p. 30), consequences of injury in sport (Cartoni, Minganti & Zelli, 2005, pp. 6-9; Udry et al., 1997, p. 235), and time of season (Cresswell & Ekland, 2007, p. 15).

V) Implications of Pain Coping in Athletes

It is clear from previous research that psychological responses to pain can influence health outcomes (McCracken et al., 1996, p. 929; McCracken et al., 1992, p. 70). However, less is known of the link between pain coping and health in an athlete population. Morrey, Stuart, Smith, and Wiese-Bjornstal (1999) studied the influence of mood and coping on 15 male and 12 female athletes' post-surgery recovery from ACL injury (p. 63). Both mood and coping resulted as significant predictors of athlete's range of motion in the injured limb (p. 65). However, this finding only occurred at the 2-week and 2-month periods post-surgery (p. 65). Mood and coping did not predict physical recovery measures at the 6-month period (p. 65). Gender differences were not tested for in this study. Given that female athletes have been found to report more anxiety towards injury (Granito, 2002, pp. 251-252), gender may have been a significant contributor to the athletes' recovery time.

Deroche, Woodman, Stephan, Brewer and Le Scanff (2011) provided evidence of a relationship between pain coping and decision-making around pain within a cohort of 205 athletes (158 males and 47 females) with recent reports of pain (p. 580-581). An important finding was that catastrophizing accounted for more variance in athletes' decisions to play through pain than did pain intensity (p. 583). This suggests that decisions, such as when to return to play following an injury, may be strongly guided by psychological responses to pain rather than the intensity of the pain.

Thompson, Eklund, Tenebaum and Roehrig (2008) investigated the influence of pain expectations on pre-competitive anxiety in sport (p. 183). In this study of pre-competitive anxiety, a total of 89 collegiate-level athletes (58 males and 31 females) were tested (p. 184). Participants completed self-report measures on pain expectancy and pre-competitive anxiety shortly before competing (p. 184-185). The findings revealed that, among athletes, there were low to moderate scores on measures of expectancy and measures of anxiety (p. 186). Contrary to their hypothesis, females did not report more pain expectations than males; no significant difference was found. However, the results did show that expectations of pain significantly correlated with pre-competitive anxiety (p. 187-191). The authors drew the conclusion that pain expectancy is an important and unique source to consider in the development of pre-competitive anxiety in athletes because of the close link between expectations and cognitive elements of anxiety (p. 192).

While the literature into the effects of pain coping on athletic performance is scarce, Birrer and Morgan (2010) highlight the importance of psychological responses to pain in athletic performance (p. 83). In their model for psychological skills training in high-intensity sport, it is proposed that pain management techniques, recovery abilities, and managing appraisals of somatic sensations are pertinent to enhancing overall performance in high-intensity sport (p. 82-84).

Anxiety is of particular importance in performance. For example, Burton (1988) studied the effects of anxiety on the performance of swimmers (46 males and 52 females) and demonstrated the potential for interference (p. 51). A significant negative correlation was found between the swimmers' scores of cognitive anxiety and performance, while the relationship between somatic anxiety and performance resulted in an inverted-U (p. 56). These results suggest that lower levels of somatic anxiety can enhance performance but higher levels can be harmful. This was not the case with cognitive anxiety; this form of anxiety produced a negative linear correlation with performance scores (p. 56). One explanation for this difference stems from Esyenck, Derakshan, Santos, and Calvo (2007) work that suggests symptoms of cognitive anxiety, such as worry, drain attention and memory resources, which results in limited cognitive ability for the task at hand (p. 348). While the anxiety tested in this study was not pain-specific, these results demonstrate the harmful effects of cognitive anxiety on performance in sport.

There is sufficient evidence to suggest pain coping can influence health outcomes in athletes. That is, particular responses to pain are linked to the duration of short-term physical recovery from injury (Morrey et al., 1999, p. 65), decisions to play through pain (Deroche et al., 2011, p. 583), and pre-competitive anxiety (Thompson et al., 2008, pp. 186-191). As well, general anxiety in athletes has potential to hinder performance (Burton, 1988, p. 56), which considering the value athletes place on performance, likely influences emotional well-being. Taken together, there is a possibility that pain coping responses can determine various aspects of an athlete's health.

VI) Summary and Current Study

Pain anxiety has important implications in sport. Maladaptive pain anxiety can increase risk of injury, contribute to long-term pain conditions, and hinder athletic performance. While it is evident that multiple psychological and physical factors must be addressed when examining pain anxiety, there are additional factors unique to athletes that must also be considered in order to fully understand pain anxiety in the context of sport.

With this said, a biopsychosocial approach was used to investigate athlete pain anxiety. The purpose of the study was to examine pain anxiety in athletes, and to identify a set of predictors in athlete pain anxiety. The research questions are as follows:

> i) How do features of pain anxiety (cognitive, escape-avoidance, fearful, and physiological features) manifest within a cohort of university-varsity athletes?
>
> ii) Through the use of relevant variables (pain type, gender, contact-grade of sport, time of season, number of injuries, injury type, missed time in sport due to injury, pain intensity, pain frequency, medication use, use of medical care, depression, anxiety, stress, and athlete identity), can pain anxiety be predicted in a cohort of young adult athletes?

It was hypothesized that the university varsity athletes would report differences among the pain anxiety components (i.e. PASS sub-scales) and that females would report higher levels of pain anxiety than males. Furthermore, it was expected that each of the selected biological, psychological, and social variables would significantly contribute to pain anxiety outcomes to differing extents across pain types (acute and chronic).

CHAPTER 3: METHODS

I) Research Design, Participants, Procedure

Each phase of this research required letters of consent (see Appendix A and B) and was approved by the University Research Ethics Board.

Phase 1 of the study used a cross-sectional design to examine the different features of pain anxiety in university varsity-level athletes. A purposive sampling approach was used to select the participants in this study. The sample was based on a cohort of university varsity athletes scheduled to participate in a pre-season screening for concussion. Athletes were selected from women and men's field hockey, soccer, basketball, ice hockey, women's rugby, and the co-ed swim team. Participation required completing a measure of pain anxiety through an online questionnaire. Testing took a maximum of 10 minutes to complete. Data were collected between August 2014 and October 2014. In total, 92 athletes (Male = 28, Female = 60, Unreported = 4) ranging from 18 to 27 years of age participated in this phase of the research.

Phase 2 examined selected predictors of pain anxiety in young adult athletes. In March 2015, varsity athletes from Phase 1 were recruited using purposive sampling. Due to low recruitment numbers, the population was expanded to include recreational athletes (i.e. any individual who participated in an organized sport) in April 2015. Athletes were invited to participate via email and Facebook. Online surveys were used to collect information about cohort demographics and selected measures of pain anxiety, depression, anxiety, stress, injury history, pain, medical visits, and athlete identity. Completion of surveys took approximately 15 to 20 minutes. A total of 84 athletes (Male = 29, Female = 53, Unreported = 2) with varying levels of pain participated in this phase of the study, and ages ranged from 18 and 29.

<u>II) Measures</u>

I) Demographics

Participants were asked to complete a demographics survey (see Appendix C). Information of interest included age, gender, school (if applicable), and sport. Participants were also asked if they had been prescribed any form of medication in the 6 months prior to testing.

II) Pain Anxiety Symptom Scale-20 (PASS)

The PASS, developed by McCracken & Dhingra (2002), measures the extent to which adults experience pain-related anxiety (p. 47) (see Appendix D). The questionnaire contains 20 questions and uses an ordinal scale ranging from 0 (never) to 5 (always). The maximum possible score for any individual responding on the PASS is 100. The PASS scale has four sub-scales measuring the extent to which pain-related anxiety manifests on the following four levels: *Cognitive, Escape/Avoidance, Fear,* and *Physiological*. The maximum possible score for each sub-scale is 25.

III) Depression Anxiety Stress Scale-21 (DASS)

The Depression Anxiety Stress Scale (DASS) (Lovibond & Lovibond, 1995) is a 21-item scale measuring depression, anxiety, and stress symptoms (p. 339) (see Appendix E). The *Depression Scale* assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia. The *Anxiety Scale* assesses autonomic arousal, skeletal muscle effects, situational anxiety, and subjective experience of anxious affect towards non-specific threats. The *Stress Scale* assesses levels of non-specific arousal including irritability, impatience, agitation, overreaction and difficulty relaxing. Scores on the DASS are rated on an ordinal scale ranging from 0 to 3. Maximum possible total score is 63 indicating higher depression, higher anxiety, and higher stress.

IV) Athlete Identity Measurement Scale (AIMS)

The Athlete Identity Measurement Scale (AIMS) is a 10-item questionnaire that measures the extent to which a person identifies with an athlete role (Brewer, Van Raalte & Linder, 1993, p. 243) (see Appendix F). A scale ranged from 0 (Strongly Disagree) to 4 (Strongly Agree) was used and the maximum possible score was 40. The *Social Identity* sub-scale captures the extent to which one views their self to be an athlete, or thinks others view them as an athlete. The *Exclusivity* sub-scale assesses the extent one relies on sport, and finally, the *Affectivity* sub-scale measures emotional upset over negative sporting outcomes.

V) Injury Reporting Form

The injury reporting form was designed by the researchers with the purpose of collecting information on participants' injuries, pain, and medical visits (see Appendix G). In relation to injury, information on the number and type of injuries sustained in the 6-months prior to testing was recorded, along with the amount of playing time missed due to injury. Participants were also asked about chronic pain. Chronic pain was defined as a type of pain that persists for more than 3 months. This criterion was chosen because it is a common characteristic used to describe the pain experienced in chronic pain conditions (Hunt et al., 1999, pp. 275-276). Athletes that had chronic pain were considered the chronic pain athletes (CPA). Those who did not possess chronic pain were identified as having acute pain (pain that is characteristic of a healthy population) and were considered to be the acute pain athletes (APA). Participants were asked to report on pain experiences that occurred in the 6-month time frame prior to testing. Ratings of pain frequency were collected using a scale that ranged from 0 (Never) to 6 (Everyday). Ratings of pain intensity were collected using a scale that ranged from 0 (No Pain) to 10 (Severe Pain). Lastly, the form collected information on medical attention sought for injury, and the number of visits to a healthcare provider (e.g. physician, physiotherapist, trainer) in the 6-months prior to testing.

III) Statistical Analysis

All data were analyzed using SAS: The Statistical Analysis System, version 9 (SAS Institute Inc.; Cary, NC). Descriptive statistics on the PASS were produced for Phase 1. Correlations between the four PASS sub-scales were also produced. Comparisons among the four PASS sub-scales were analyzed using a parametric one-way ANOVA: (i) Cognitive, ii) Escape/Avoidance, iii) Fearful, and iv) Physiological. To test for directional differences between males and females on the five pain anxiety outcomes (total PASS measure and the four PASS sub-scales), one-tailed independent student's t-tests were used.

The goal of Phase 2 was to identify a set of predictor variables for pain anxiety. First, descriptive statistics were produced for the PASS data followed by correlation analysis between the PASS sub-scales. Parametric analysis using a one-way ANOVAs was used to compare outcomes on each of the four PASS sub-scales. One-tailed independent t-tests were used to test for directional differences between male and female outcomes on the total PASS measure and the four PASS sub-scales.

Further, to test the predictability of seasonal changes in pain anxiety, one-tailed independent student's t-tests were used. A one-tailed test was chosen, as the direction of the difference was being analyzed. Pre and post-season ratings on the total PASS and each of the four PASS sub-scales were compared, followed by a 2x2 repeated measures ANOVA of season by gender.

Descriptive statistic analyses were computed for the remaining predictor variables (contact grade of sport, injury, pain, medical history, depression, anxiety, stress, and athlete identity).

Finally, linear regression was used to predict pain anxiety outcomes separately for the APA and CPA. This approach was chosen because chronic pain populations demonstrate unique biological and psychological characteristics that set them apart from non-chronic pain groups (i.e. persistent pain and increased rates of psychopathology) (Currie & Wang, 2004, p. 57; Dersh et al., 2002, pp. 776-783; Polatin et al., 1992, p. 67). Therefore, it was thought that this approach would strengthen the accuracy of results. Data was evaluated using various approaches in which the dependent variables, i) total pain anxiety (PASS) score, ii) total Cognitive sub-scale score, iii) total Escape/Avoidance sub-scale score, iv) total Fearful sub-scale score, and v) total Physiological sub-scale score, were compared against scores on the questionnaires. Five regression models were built for both the APA and CPA in the pain anxiety outcomes on the total PASS as well as the four PASS sub-scales.

CHAPTER 4: RESULTS

The results section is divided into two sections: Phase 1 and Phase 2. The first phase (Phase 1) presents the results of self-reported pain anxiety (PASS and the four PASS sub-scales) from the 92 university varsity athletes. The second phase (Phase 2) presents the results of a variety of self-reports (gender, contact grade of sport, pain anxiety, injury, pain, medical history, depression, general anxiety, stress, and athlete identity) from the 84 young adult athletes. T-tests, analyses of variance, and linear regression were used in this phase to determine the predictability of the variables in pain anxiety outcomes.

I) Phase 1

Descriptive statistics were computed to determine the characteristics of the pain anxiety scores at pre-season (N = 92) (see Table 1). The mean total score on the Pain Anxiety Symptoms Scale-20 was 20.58 (s = 13.27) with 1.38 as the standard error. The confidence interval of the total PASS scores ranged from 17.88 to 23.28 and the

Table 1. Descriptive Statistics for University Athletes' PASS scores (N = 92) (Phase 1).

Variable	Mean	Standard Deviation	N	Standard Error	95% CI (LL)	95% CI (UL)	Coefficient of Variation
Total PASS	20.58	13.27	92	1.38	17.88	23.28	.65
Cognitive	8.02	4.57	92	.48	7.08	8.96	.57
Escape/Avoidance	5.81	3.86	92	.40	5.03	6.59	.66
Fearful	3.89	3.87	92	.40	3.11	4.67	.99
Physiological	3.05	3.61	92	.38	2.30	3.80	1.18

maximum score was 64 (maximum possible score = 100).

To determine the estimate of internal consistency, Chronbach's alpha was calculated for the PASS. This analysis was done to ensure that each of the PASS items measured the construct of pain anxiety in this cohort. The Chronbach's alpha was .93 based on rounded raw, indicating strong internal consistency of the PASS measure.

Pearson correlations were generated to test for relationships between each of the sub-scale scores (see Table 2). Results indicated strong significant correlations between each of the sub-scales. The Pearson coefficients ranged from .46 to .69.

Using a parametric analysis, a one-way ANOVA was performed to test for significant differences among PASS sub-scale mean scores (see Figure 2). Findings revealed a significant difference among the mean sub-scale scores ($F(3) = 27.92$, $p < .05$). A Sheffe's test indicated significant differences between each of the sub-scale pairs, with

Table 2. Correlations between PASS Sub-Scales (Phase 1).

	Cognitive	Escape/Avoidance	Fearful	Physiological
Cognitive	1.00	.69 $p < .0001$	.62 $p < .0001$	.62 $p < .0001$
Escape/Avoidance	-	1.00	.67 $p < .0001$	.46 $p < .0001$
Fearful	-	-	1.00	.49 $p < .0001$

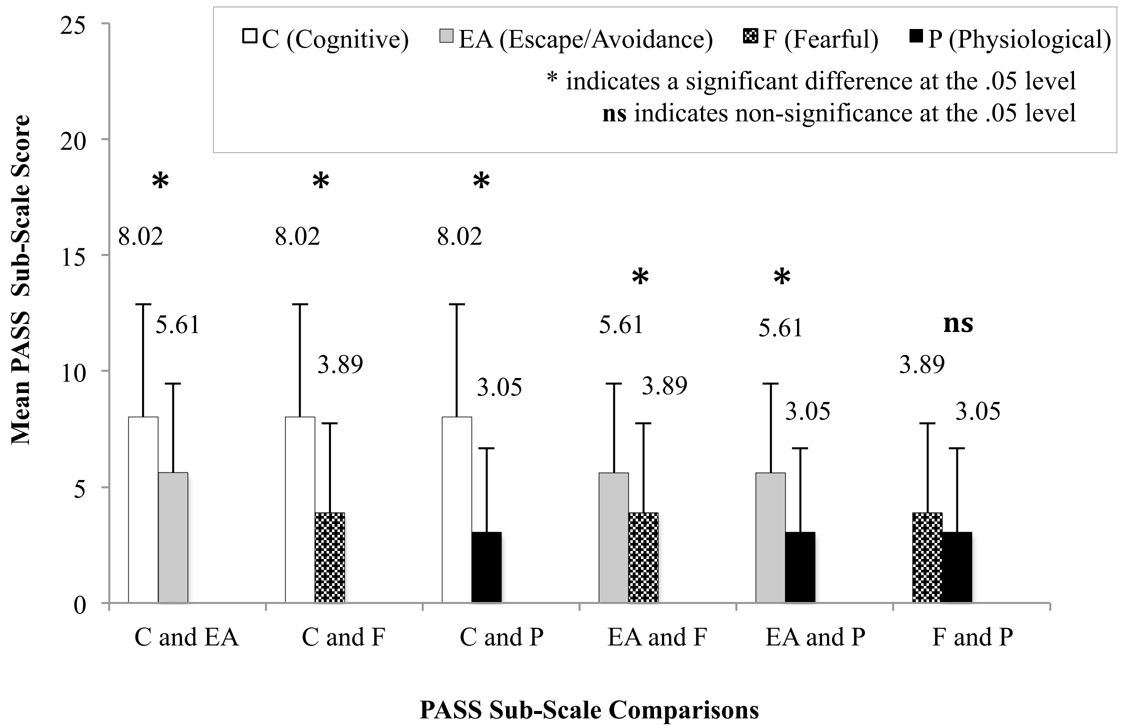

Figure 2. PASS Sub-Scale Comparisons (Phase 1).
Results from a Scheffe's post-hoc analysis to test for differences between PASS sub-scale means.

the exception of the Fearful and Physiological sub-scale means.

To determine if directional differences existed in male and female pain anxiety, one-tailed independent Students t-tests were used for each of the pain anxiety outcomes (see Figure 3). The mean total PASS score for females was 22.05 ($s = 14.15$) and 16.93 ($s = 9.87$) for males, and this difference was significant ($p < .05$). Furthermore, females demonstrated a significantly higher mean on each of the PASS sub-scales than males with the exception of the Physiological sub-scale: Cognitive (M: $\bar{x} = 6.86$, sd = 3.69, F: $\bar{x} = 8.48$, sd = 4.77), Escape-Avoidance (M: $\bar{x} = 4.50$, sd = 3.34, F: $\bar{x} = 6.03$, sd = 3.97), Fearful (M: $\bar{x} = 2.96$, sd = 2.50, F: $\bar{x} = 4.33$, sd = 4.25), and Physiological (M: $\bar{x} = 2.61$,

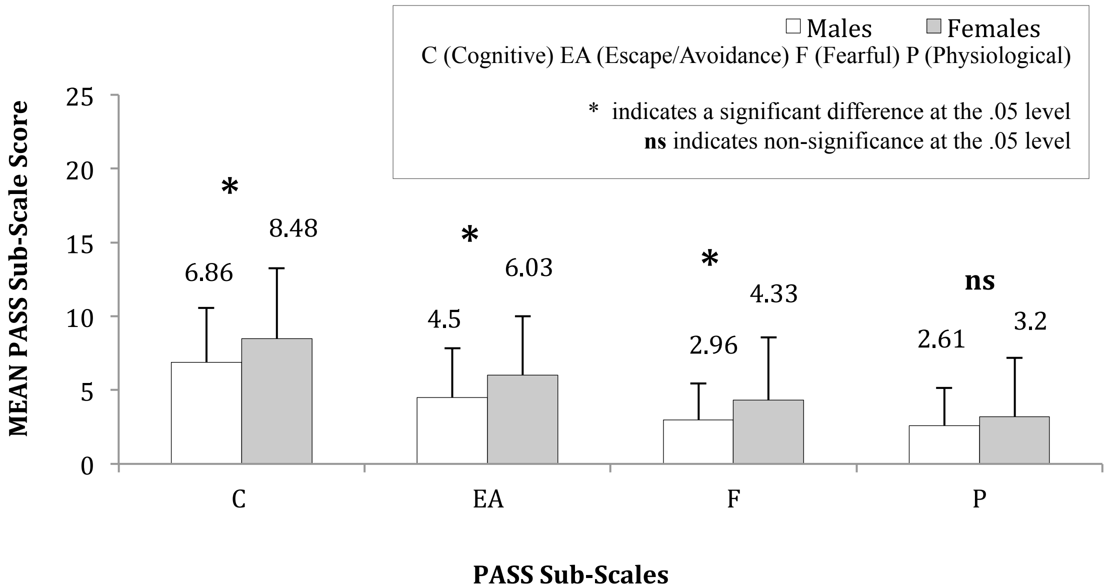

Figure 3. Gender Differences in Pain Anxiety Outcomes (Phase 1).
Results from a one-tailed independent t-test that tested fro changes in pain anxiety between male and female athletes.

sd = 2.53, F: $\bar{x}$ = 3.20, sd = 3.97). Homogeneity of variance could only be assumed for the Cognitive and Avoidance sub-scales, as determined by the Levene's test.

II) Phase 2

I) Total Group Analyses

Descriptive statistics were computed to determine the characteristics of pain anxiety in the cohort of young adult athletes (N = 84) (see Table 3). The mean PASS score was 27.85 (s = 13.66) with a 1.49 standard of error. The upper and lower limits of the 95% confidence interval were at 30.77 and 24.93, and the maximum PASS score was 61.

Table 3. Descriptive Statistics for Athletes' PASS scores (N = 84) (Phase 2).

Variable	Mean	Standard Deviation	N	Standard Error	95% CI Lower Limit	95% CI Upper Limit	COV[b]
Total PASS	27.85	13.66	84	1.49	24.93	30.77	.49
Cognitive	10.46	5.20	84	.57	9.34	11.58	.50
Esc/Avd[a]	7.11	3.89	84	.43	6.27	7.95	.55
Fearful	5.50	4.37	84	.48	4.56	6.44	.80
Physiological	4.77	3.98	84	.43	3.93	5.61	.83

Note: a=escape/avoidance, b=coefficient of variation.

Chronbach's alpha was calculated for the PASS to determine the estimate of internal consistency within this particular cohort. The alpha value of .90 (rounded raw) indicated that pain anxiety was indeed being measured. This value from the item analysis demonstrated strong internal consistency of the PASS measure.

The proportional distribution of the PASS sub-scales displayed a similar pattern as seen in Phase 1. The Cognitive sub-scale displayed the highest mean, followed by the escape/avoidance, fearful, and physiological means.

Pearson correlations were used to test for relationships between each of the sub-scale scores (see Table 4). Results indicated moderate to strong significant correlations between each of the sub-scales. The Pearson coefficients ranged from .34 to .57.

Table 4. Correlations between PASS Sub-Scales (Phase 2).

	Cognitive	Escape/Avoidance	Fearful	Physiological
Cognitive	1.00	.45 p < .0001	.57 p < .0001	.46 p < .0001
Escape/Avoidance	-	1.00	.48 p < .0001	.34 p < .01
Fearful	-	-	1.00	.57 p < .0001

A one-way parametric ANOVA was performed to test for significant differences among PASS sub-scale mean scores (see Figure 4). Findings revealed a significant difference among the mean sub-scale scores ($F (3) = 27.93$, $p < .0001$). A Sheffe's test indicated significant differences between each of the following sub-scale pairs: Cognitive and Escape/Avoidance, Cognitive and Fearful, Cognitive and Physiological, and Escape/Avoidance and Physiological.

To test for gender differences on each of the five pain anxiety outcomes, one-tailed independent t-tests were used. While female athletes displayed higher means on four out of the five pain anxiety measures (total PASS, Cognitive, Fearful, and Physiological), these differences were not significant. Levene's tests indicated that homogeneity of variance could be assumed on each pain anxiety measure.

Descriptive statistics were computed for each of the predictor variables. These measures assessed gender, contact grade of sport, pain, injury and medical history, depression,

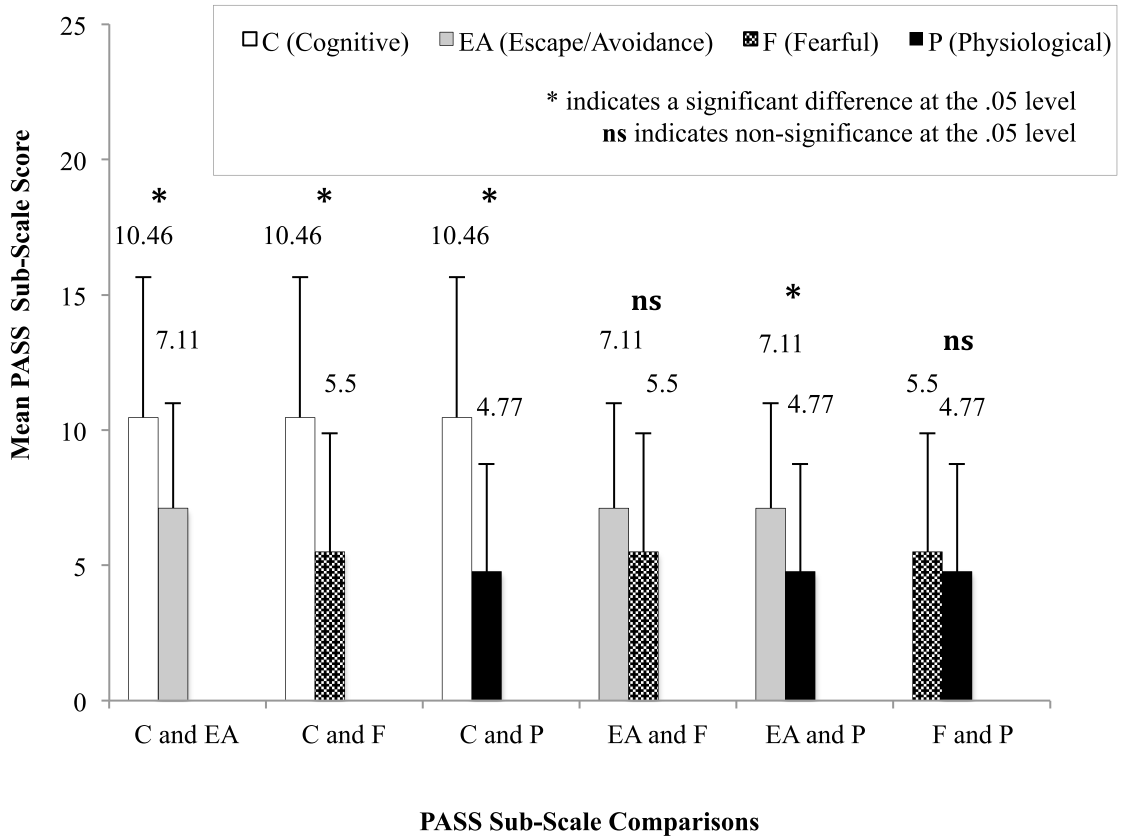

Figure 4. PASS Sub-Scale Comparisons (Phase 2).
Results from a Scheffe's post-hoc analysis to test for differences between PASS sub-scale means.

anxiety, stress, and athlete identity. Beginning with demographics, 29 athletes were male, 53 athletes were female, and 2 did not report a gender. In total, 14 athletes play limited-contact sport, 51 played contact sport, 16 played collision sport, and 3 were unreported.

For the pain ratings, 38.82% of the athletes reported chronic pain. Of the chronic pain group, 50% reported the pain to be located in the extremities, 29.41% in the torso, 5.88% in the neck or head, and 14% reported more than one location. Of the total group (both acute and chronic pain), athletes' pain intensity ratings ranged from *No Pain* to *Severe*, while the pain frequency ratings ranged from *No Pain* to *Everyday.*

On the injury reports, 67% reported at least one injury occurrence in the 6 months prior to testing. Athletes most frequently reported sustaining 1 injury. The most commonly reported injury was muscle strain, sprain, or tear, while the least reported injury was tendon or ligament rupture. On the reports of missed playing time due to injury, 4.65% reported missing no time, 24.71% missed 1 to 2 days, 5.88% missed 3 to 4 days, and 31.76% missed 5 or more days. The remaining 33% of these reports consisted of the injury-free athletes who did not miss any playing time.

In the 6 months prior to testing, 13.58% reported being prescribed some form of medication. Medication types included anti-inflammatories, antidepressants, and antibiotics. As well, 55% of the total group of athletes sought some form of medical attention for injury. Within the group who reported seeking medical attention, the most frequently selected response was "1 to 2 visits."

Emotional stress was measured using the Depression Anxiety Stress Scale-21 (DASS). The mean DASS score was 9.39 ($s = 9.70$) with a 1.08 standard error. The 95% confidence interval ranged from 7.26 to 11.52, and overall, the DASS displayed high variance (coefficient of variation = 1.03). Further analyses were computed on the DASS sub-scales. Participants scored a mean of 2.46 on the Depression sub-scale ($s = 3.35$), 2.64 ($s = 3.32$) on the Anxiety sub-scale, and 4.29 ($s = 3.72$) on the Stress sub-scale.

The Athlete Identity Measurement Scale (AIMS) produced a mean of 30.08 ($s = 4.69$; $SE = .78$) and displayed low variance (coefficient of variation = .16). The 95% confidence interval ranged from 28.50 to 31.61. Results from each of the sub-scales are as follows: Self-Identity ($\bar{x} = 10.50$; $s = 1.54$), Social Identity ($\bar{x} = 6.56$; $s = 1.58$), Exclusivity ($\bar{x} = 6.53$; $s = 2.41$), and Negative Affect ($\bar{x} = 6.50$; $s = 1.61$).

II) Retested Athletes: Pain Anxiety across Season

The sample was comprised of 28 university varsity athletes who participated in Phase 1 of the research. Phase 1 occurred at the beginning of the athletes' seasons and produced a preseason PASS mean ($\bar{x} = 20.00$, $s = 11.89$). Phase 2 of the research occurred at the end of the athletes' seasons, which produced a postseason PASS mean ($\bar{x} = 24.54$, $s = 13.34$).

To analyze for significant differences between pre and postseason pain anxiety, a one-tailed dependent t-test was conducted. The results indicated no significant difference ($p = .09$) between total PASS means. Each of the postseason PASS sub-scales revealed higher means than those from preseason, therefore these differences were also analyzed. A one-tailed dependent t-test produced only one significant difference, which was between the pre and postseason means from the Physiological sub-scale ($p < .01$) (see Figure 5). However, homogeneity of variance could not be assumed for this sub-scale measure. In conclusion, this cohort of athletes experienced little change in pain anxiety across the season.

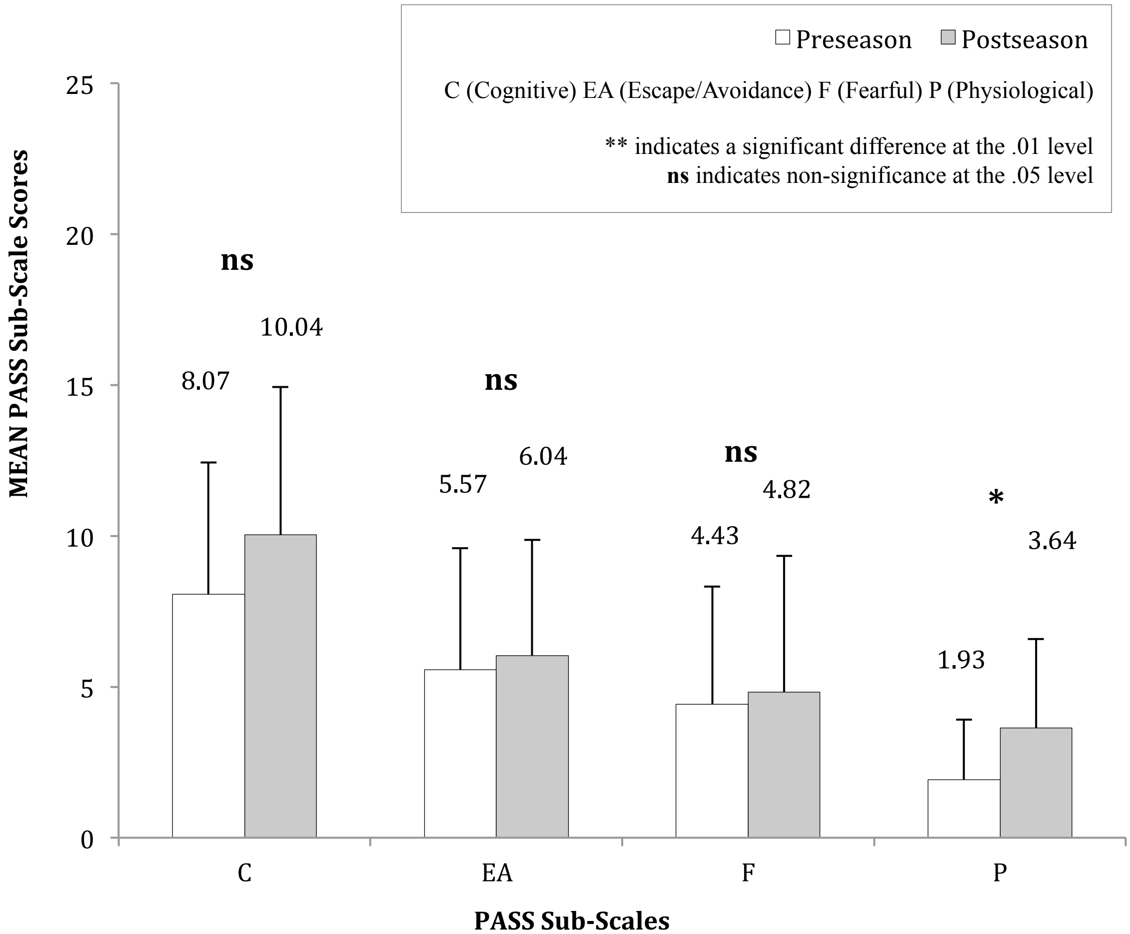

Figure 5. Changes in University Athletes' PASS scores by Season (N = 28) (Phase 2). *Results from a one-tailed dependent t-test to test for significant differences in athletes' PASS sub-scale means between pre and postseason.*

Given that gender is an important factor in pain (Armstrong & Khawaja, 2002, p. 13; Bingefors & Iverson, 2004, p. 438; Pennebaker, 1982, p. 139; Tsang et al., 2008, p. 887), a 2x2 repeated measures ANOVA was conducted to test for interactions between season and gender on pain anxiety outcomes. No significant interactions were found for outcomes of total PASS ($F = .09$, $p = .76$), Cognitive ($F = .10$, $p = .75$), Escape/Avoidance ($F = .03$, $p = .86$), Fearful ($F = .05$, $p = .82$), or Physiological ($F = .08$, $p = .78$) measures.

III) Linear Regression across Pain Groups

Linear regression analyses were used separately for the APA and CPA to determine predictive models for the total PASS measure and each of its sub-scales. Means on each of the pain outcomes were produced for both groups of athletes (see Table 5). For the regression analyses, backward elimination was used and the significance level was set at .05 for the overall model and .1 for selection of predictor variables. Each of the models were produced without the intercept, and R-squared values were used to select the best predictive models. The R-squared values reflect the percentage of variance explained by each model. Finally, parameter estimates and associated probability values were also included to demonstrate the strength of each predictor variable within the models. Five models resulted for the both the APA (Models 1-5) and APA (Models 6-10). The following variables were entered into the equations when testing the regression

Table 5. Mean scores of Acute and Chronic Pain Athletes by Gender on Pain Variables (Phase 2).

Acute Pain Athletes

	PASS	Cog[a]	Esc/Avoid[b]	Fear[c]	Physio[d]	PI[e]	PF[f]
Male	22.5	8.7	6.1	4.4	3.4	3.8	2.4
Female	26.5	10.3	6.7	5.4	4.2	3.2	2.1

Chronic Pain Athletes

	PASS	Cog	Esc/Avd	Fearful	Physio	PI	PF
Male	29.2	10.2	8.3	5.9	4.9	3.9	5.0
Female	25.9	10.3	6.2	4.8	4.0	4.5	4.8

Note: a=cognitive, b=escape/avoidance, c=fearful, d=physiological, e=pain intensity, f=pain frequency.

models: *medication, gender, contact, stress, pain frequency, pain intensity,* and *missed time.*

These variables were chosen because of their predictive strength and relevance. That is, regressions were initially conducted with pain, number of injuries, contact, depression, anxiety, and stress. Given that the FAM places particular importance on many of these factors in maintaining a fear of pain (Leeuw et al., 2007, p. 79; Vlaeyen et al., 1995a, p. 238; Vlaeyen & Linton, 2000, p. 320), it was thought that this combination would yield strong predictability. However, number of injuries, depression, and anxiety had poor predictability in the pain anxiety outcomes. Athlete identity was then tested with the pain variables, however, these did not produce strong models. Demographic variables were thought to play an important role, and therefore were included in the analyses. After including gender and medication into the model, both of these variables proved to be strong predictors of pain anxiety outcomes. Finally, it was suspected that missed playing time due to injury may mediate the relationship between stress and pain anxiety, therefore as a final decision, missed time was added into the equation. This increased the strength of a portion of the models. The ten resulting models explained between 57 and 82 percent of the variance in pain anxiety outcomes (see Table 6).

i) Acute Pain Athletes

(Model 1) Backward Linear Regression: Total PASS Scores

Following five steps of elimination, gender, contact, and stress remained as significant predictors of total pain anxiety scores. The APA that reported being female, participation

Table 6. Statistical Outcomes for Linear Regression Models (Phase 2).

	R^2	F-value	Pr > F	Standard Error
Model 1	.80	84.94	<.0001	3
Model 2	.82	98.05	<.0001	3
Model 3	.75	101.15	<.0001	2
Model 4	.59	95.08	<.0001	1
Model 5	.59	31.72	<.0001	3
Model 6	.75	51.09	<.0001	2
Model 7	.78	59.86	<.0001	2
Model 8	.66	67.76	<.0001	1
Model 9	.57	46.54	<.0001	1
Model 10	.67	16.41	<.0001	4

Note: Acute Pain Group is Models 1-5 and Chronic Pain Group is Models 6-10.

in higher contact-grade sports, and higher stress reported higher levels of pain anxiety. The R^2 value for the final model was .80. The following is the equation for Model 1:

PASS Scores = 8.14 (Gender) + 3.44 (Contact) + 1.24 (Stress)

(Model 2) Backward Linear Regression: Cognitive Sub-Scale Scores

After five steps, the remaining significant variables consisted of medication, gender, and stress. The APA that reported no medication, being female, and higher stress reported higher levels of cognitive pain anxiety. The R-Squared value was .82. The following equation for Model 2 is as follows:

Cognitive Scores = 2.04 (Medication) + 2.21 (Gender) + .63 (Stress)

(Model 3) Predictive Linear Regression: Escape-Avoidance Sub-Scale Scores

After six steps of elimination, gender and contact were the remaining significant variables in the model. The APA that reported being female and participation in higher contact-grade sports reported higher levels of escape-avoidance behaviour in pain. The R^2 value was .75. The following is the regression equation for Model 3:

Escape-Avoidance Scores = 1.97 (Gender) + 1.54 (Contact)

(Model 4) Backward Linear Regression: Fearful Sub-Scale Scores

Seven steps of elimination occurred, and only gender remained as a significant predictor in the model. The APA that reported being female reported higher levels of fearful pain anxiety. The R^2 value was .59. The following is the regression equation for Model 4:

Fearful Scores = 2.92 (Gender)

(Model 5) Backward Linear Regression: Physiological Sub-Scale Scores

After five steps of elimination, the following variables remained as significant predictors: gender, stress, and missed time. The APA that reported being female, higher stress, and more frequent missed time in sport reported higher levels of physiological pain anxiety. The R^2 value was .59. The following is the equation for regression Model 5:

Physiological Scores = 1.00 (Gender) + .40 (Stress) + .91 (Missed Time)

ii) Chronic Pain Athletes

(Model 6) Backward Linear Regression: Total PASS Scores

Following six steps of elimination, medication and pain intensity remained as significant predictors of total pain anxiety scores. The CPA that reported no medication and higher pain intensity reported higher pain anxiety. The R^2 value for the final model was .75. The following is the equation for Model 6:

PASS Scores = 7.52 (Medication) + 2.73 (Pain Intensity)

(Model 7) Backward Linear Regression: Cognitive Sub-Scale Scores

After six steps, the remaining significant variables consisted of medication and pain intensity. The CPA that reported no medication and higher pain intensity reported higher cognitive pain anxiety. The R^2 value was .78. The following equation for Model 7 is as follows:

Cognitive Scores = 2.91 (Medication) + 1.00 (Pain Intensity)

(Model 8) Backward Linear Regression: Escape-Avoidance Sub-Scale Scores

After seven steps of elimination, medication was the remaining significant variable in the model. The CPA that reported no medication reported higher levels of escape-avoidance behaviour in pain. The R^2 value was .66. The following is the regression equation for Model 8:

Escape-Avoidance Scores = 3.44 (Medication)

(Model 9) Backward Linear Regression: Fearful Sub-Scale Scores

Seven steps of elimination occurred, and only medication occurred as a significant predictor in the model. The CPA that reported no medication reported higher levels of fearful pain anxiety. The R^2 value was .57. The following is the regression equation for Model 9:

Fearful Scores = 2.80 (Medication)

(Model 10) Backward Linear Regression: Physiological Sub-Scale Scores

After four steps of elimination, the following variables remained as significant predictors: medication, contact, stress, and missed time. The CPA that reported no medication, participation in lower contact-grade sports, higher stress, and frequent missed time from sport reported higher levels of physiological pain anxiety. The R^2 value was .67. The following is the equation for regression Model 10:

Physiological Scores = 2.46 (Medication) – 1.93 (Contact) + .42 (Stress) + .89 (Missed Time)

CHAPTER 5: DISCUSSION

I) Summary of Findings

The aim of the present study was two-fold. The first objective was to examine reports of pain anxiety in university varsity-level athletes (Phase 1). The second objective was to test the predictability of selected variables in pain anxiety reports within a cohort of young adult athletes from various levels of play (Phase 2). The Phase 1 hypothesis proposed that athletes would display varying levels of pain anxiety features. This hypothesis was confirmed, as the athletes demonstrated significant differences between each of the pain anxiety sub-scales, with the exception of the Fearful and Physiological sub-scales. It was also hypothesized that females would report higher pain anxiety than males. This was the case for the majority of pain anxiety outcomes with the exception of the physiological sub-scale. The Phase 2 hypothesis maintained that the selected group of variables would be predictive of athletes' pain anxiety ratings. This hypothesis was partially confirmed, as differing combinations of gender, medication, pain ratings, contact, stress, and missed playing time contributed to the explanation of variance in pain anxiety ratings in both the APA and CPA.

The Phase 1 results revealed two important findings when interpreting athletes' PASS scores in relation to McCracken and Dhingra (2002)'s data from an older age chronic pain population (p. 48). First, it was interesting to see that the Cognitive sub-scale means and standard deviations of the athletes did not drastically differ from McCracken and Dhingra's (2002) data (Phase 1 Athlete $\bar{x} = 8.02$, $s = 4.52$; McCracken and Dhingra's (2002) Chronic Pain Pop. $\bar{x} = 12.27$, $s= 6.73$) (p. 48). In approximation, the athletes' mean was only one third less than the chronic pain population on this sub-scale. This suggests that although athletes often demonstrate high pain tolerance (Tesarz et al., 2012, p. 1256), it should not be assumed that athletes do not respond anxiously to pain. This is confirmed when considering that the Phase 2 athletes' Cognitive sub-scale mean was merely less than a quarter below McCracken and Dhingra's population (Phase 2 Athlete $\bar{x} = 10.46$, $sd = 5.20$).

Second, the proportional distribution of the Phase 1 PASS sub-scale means is not only similar to the results from Phase 2, but also to the results seen in the chronic pain population (McCracken & Dhingra, 2002, p. 48). The cognitive elements (worry and hypervigilance) appear to be the most evident, followed by escape/avoidance, fearful, and then physiological responses. These findings suggest that pain anxiety develops in much the same way across populations.

Such findings may have important implications for treating maladaptive anxiety and fear towards pain. For instance, in knowing specific patterns within pain anxiety, treatment approaches can be tailored to target the commonly reported features, which appear to include worry and hypervigilance. In cases of excessive anxiety, patients may best be managed through interventions aimed at reducing the cognitive symptoms of anxiety. Individuals who exhibit a lack of anxiety towards pain may best be treated with interventions that encourage consideration of the future consequences of pain, as well as, promoting an increase in body awareness.

The results from Phase 2 revealed three main findings: 1) gender strongly influenced pain anxiety in the APA, whereas pain anxiety in the CPA was primarily linked to pain intensity, 2) in APA, pain nor injury influenced athletes' pain anxiety, but rather, anxious responses corresponded with stress and missed time in sport, and finally 3) the effects of contact sport on pain anxiety were dependent on pain type.

Distinct predictor models for pain anxiety outcomes were found for APA and CPA. The primary predictor of pain anxiety in the acute pain group was gender, indicating that females reported higher levels of pain anxiety. This finding reflects the results from Phase 1, which revealed higher pain anxiety ratings among female athletes compared to male athletes. Such findings are in line with Hall and Davies' (1991) research that showed female athletes report significantly higher pain affect than male athletes during the Cold Pressor Task (p. 783).

This outcome could be attributed to biological differences in male and female pain processing that produce higher pain intensities in women. For instance, sex hormones have been identified as significant contributors to pain (Cairns & Gazerani, 2009, p. 294; Wiesenfeld-Hallin, 2005, p. 141). Testosterone and estrogen have close neural connections to the endogenous opioid system (Wiesenfeld-Hallin, 2005, p. 141), and fluctuations in estrogen levels appear to increase pain as do low levels of testosterone (Cairns & Gazerani, 2009, p. 294).

More recent research suggests that specific biological mechanisms may be responsible for gender differences in pain sensitivity. Sorge et al. (2015) found that in male mice, microglia cells facilitate mechanical pain sensitivity, whereas this same form of pain processing in female mice relies on immune cells other than microglia. Although not yet proven, these sex differences in pain processing may also exist in humans.

Women could also experience pain more intensely due to differences in the emotional processing of pain. In a study with healthy individuals, Kano et al. (2013) found that during anticipation of experimental pain, women demonstrated higher activity in the motor cortex and occipital visual regions prior to pain induction than did men (p. G692).

It was proposed that the thought of pain in women triggered the desire to physically escape from pain (pp. G695-G696) and initiated hypervigilance to pain cues (p. G696).

Further evidence supports the notion of higher pain affect in women. Compared to men, women are more equipped to learning predictive fear cues in visceral sensation (Benson et al., 2014, p. 116). Using a classical conditioning paradigm (p. 114), Benson et al. (2014) found that patterns of brain activity in the female insula suggest that women respond more to pain cues than do men (pp. 116-188). In addition, women also showed more activity in the hippocampus, thalamus, and cerebellum when re-exposed to the extinguished conditioned stimulus (p. 116). The authors interpreted this finding as a greater capacity to retrieve fearful memories of visceral sensation compared to men (p. 119). These results show how females might be biologically more susceptible than men to developing and sustaining pain-related fears.

Socialization also contributes to gender differences in pain. For instance, a study with male Canadian athletes found that much of sport culture portrays serious injury as “a masculizing experience” (Young, McTeer & White, 1994, p. 175). This may encourage men to view injury in a positive light. Furthermore, many female athletes have been marginalized by social influences, particularly the media (Daddario, 1994, pp. 276-277). Therefore, women may experience more pressure to prove themselves in their athletic ability than do men. Eccles and Harold (1991) found evidence to suggest that this ideology develops in girls as young as age eleven and continues into adolescence (pp. 19-21). Given that pain can be a major limitation in athletic ability, as Cassidy notes (as cited in Wrisberg & Fisher, 2006, p. 57), pain anxiety may result. In fact, Granito (2002) found that injured female athletes were more likely to express concerns over future health than did injured male athletes (pp. 251-252). Similarly, Cassidy found female athletes experienced more injury anxiety than injured male athletes (as cited in Wrisberg & Fisher, 2006, p. 57). Thus, social processes may also influence gender differences in pain anxiety.

The absence of gender differences in the CPA was unexpected. However, this could have resulted from a failure to consider the quality of pain experienced by this group. The strength of gender effects often differs across heat, cold, and pressure pain (Hurley & Adams, 2008, p. 5). While this study recorded pain ratings, data on pain characteristics was not collected. Therefore, the quality of the athletes' pain could have prevented a significant difference in pain anxiety for this group.

Predictor models for pain anxiety in the CPA were distinct from those with the APA. Pain intensity was a significant influence of pain anxiety in the chronic pain group. That is, pain anxiety was higher when athletes reported not taking medications that would affect pain (anti-inflammatories, antibiotics, and antidepressants) and reported experiencing high pain intensities. This was not seen in the acute pain group.
This finding indicates that anxious responses towards intense pain varied among the APA, whereas in the CPA, higher intensities elicited higher anxiety. This finding makes sense because athletes with persistent pain conditions benefit from monitoring levels of pain and expressing concern when intensities increase. As Barlow (2004) notes, anxiety

can help facilitate planning and problem-solving as a means of prevention (p. 9). With chronic pain, this may manifest as seeking out medical attention or avoiding aggravation of the injury.

This positive correlation between pain intensity and pain anxiety is highly adaptive. It is likely that the APA did not demonstrate this relationship because of differing ideologies towards pain. That is, some of the APA may have responded appropriately to pain, while others adopted the stoic persona that is often seen in sport (Nixon, 1993, p. 183; Safai, 2003, p. 128). Given that these athletes did not have a chronic pain condition, it is likely easy for some to dismiss pain and perceive it as merely temporary.

The number of injuries sustained in the 6-months prior to testing also had no influence on pain anxiety in the APA. If pain anxiety is not proportional to the pain or physical condition, this can be maladaptive. Anxious responses to pain serve as a protective factor against further damage (Woolf, 2004, p. 441). More specifically, pain anxiety encourages cautious behaviour and safer decision making in respect to subsequent play following injury (Raudenbush et al., 2012, p. 85). An interesting finding with the APA was that stress and missed play due to injury accounted for differences in pain anxiety. Seemingly, the health status of these athletes had no influence on fearful reactions to pain; rather, fearful reactions to pain were influenced by missed time from sport.

Past research is consistent with the findings presented here. According to Hammond, Lilley, Pope, Ribbans and Walker, pain is not used as a signal of injury in athletes (as cited in Hammond, 2014, p. 17). Instead, athletes have been found to rely on a decline in performance in injury assessments (p. 17). Furthermore, in a qualitative analysis of four injured division 1 athletes, each of the athletes reported playing through the injury (Madrigal & Gill, 2014, p. 291). Taken together, the threat-value of time away from sport seems to take precedence over the threat-value of pain. Deroche et al. (2011) found athletes to dismiss pain for the sake of play (p. 584). While it may be argued that this is conducive to facilitating athletes' injury recoveries and pain coping abilities, it can also be argued that this puts the athlete at risk for serious harm.

The "culture of risk" seen within sport can be looked to in interpreting the lack of connection between health factors and pain anxiety. Pain has become normalized within sport (Nixon, 1992, p. 188). To athletes, pain is not to be expressed to others (Waldron & Krane, 2005, p. 324), and the experience of pain is often encouraged (Young et al., 1994, p. 175). However, such ideologies seem to be difficult to break. Athletes sacrifice health in exchange for powerful reinforcers that consist of continued participation (Chrisman, Quitiquit & Rivara, 2013, p. 332), social acceptance from teammates, coaches, physicians, and fans (Nixon, 1993, p. 187; Pike & Maguire, 2003, p. 239; Safai, 2003, pp. 130-131; Waldron & Krane, 2005, p. 324), maintaining an income (O'Connell, 2012, p. 17), and perhaps even confirmation of identity.

Contrary to expected, higher contact-grades in the APA predicted more escape/avoidance behaviour, whereas higher contact in the CPA predicted lower physiological pain anxiety. It was thought that an inverse relationship would exist between contact and pain anxiety in the APA, indicating desensitization effects on less severe pain. Likewise, this relationship was expected to be positive in the CPA, implying sensitization in athletes with more severe pain. This likely resulted because these outcomes were not generated from desensitization measures. In this study, responses to pain were assessed on the cognitive-evaluative and affective-motivational components of pain, not sensory-discriminative. Although habituation can occur at the cognitive and affective levels (Walker, 1976, p. 27), desensitization within the nervous system relies on mechanisms within sensory processing (p. 23).

Frequent avoidance behaviour in the APA from high contact sport could stem from the intense physical demands of the sport. That is, these athletes may avoid pain-eliciting activities outside their sport as a means of preserving their health for athletic performance. In contrast, athletes from contact and limited-contact sport may not place as much value on physical health, and thus are less cautious with pain. Lower responses of physiological pain anxiety in the CPA in high contact sport could be attributed to attentional processes. It could be that these athletes do indeed experience the physiological arousal from anxiety, but the frequent contact aggravates the chronic pain condition to a point where the chronic pain becomes the dominant stimulus in the field of awareness and sensations of anxiety go unnoticed. In contrast, the CPA from lower contact sports may have had less severe pain than the high contact CPA, which allows for better recognition of physiological arousal in anxiety.

II) Conclusion

Sources of pain anxiety differ for athletes with acute and chronic pain. Primarily, pain anxiety is influenced by pain intensity in chronic pain conditions, whereas pain anxiety is influenced by gender when pain experiences are acute. Furthermore, athletes without chronic pain seem to lack an adaptive form of pain anxiety. Neither injury occurrence nor pain predicted outcomes in this group's pain anxiety, yet stress and time away from sport showed predictive value. Lastly, contact-grades appear to play a role in pain anxiety but this relationship changes across pain type.

In its entirety, this research shows that acute and chronic pain groups need to be addressed separately when understanding athlete pain. These between-group differences could have important implications in both medical care and sport. Pain management approaches may benefit from adjusting for the needs of these independent groups. For example, in knowing the significance of pain intensity to chronic pain sufferers, health professionals and coaches can be more cognizant of the emotional symptoms associated with these conditions. In addition, educational interventions emphasizing the risks of playing through injury may help instill protective responses in healthy athletes, which seems particularly crucial for males.

III) Limitations

The sample size of Phase 2 of the research was not as large as desired (N = 84). This may limit the generalizability of the results, as the means in this study may not accurately reflect the means of the athlete population. This is especially true for the analysis with the Athlete Identity measure. Only 34 participants were able to complete this measure due to issues with the data collection tool. This is likely the reason for its poor predictability. Furthermore, females outnumbered the male athletes in the ratios of female to male participants in the acute and chronic pain groups. Caution should be taken in generalizing these results to an athlete population.

Participants were recruited using convenience sampling rather than random selection, which also limits the generalizability. However, expanding the participants from university varsity athletes to all forms of athletes helped to increase the diversity of the sample. This expansion made it more likely to attain a sample that was an accurate reflection of the athlete population.

Another limitation is that the measures in this study consisted of self-reports. Therefore, the measures were not an objective assessment of the variables under investigation. Given that athletes are often reluctant to report physical health issues (Waldron & Krane, 2005, p. 324), this may have created potential for participant bias. Nonetheless, during both recruitment and completion of consent, participants were assured that responses were kept strictly confidential as a means of mitigating this effect.

Furthermore, while participants were instructed to reflect on experiences with general pain when responding to the pain anxiety and pain questions, it is uncertain of the type of pain the participants referred to. For instance, some athletes may have drawn upon memories of mild pain whereas others may have referred to experiences with severe pain.

This could be an issue, as anxious responses are likely to differ when the threat-level of the pain differs. According to Deroche et al. (2011), pain can range from harmful to benign, which causes difficulty in interpreting the results of examinations with generalized pain (p. 585). An undetermined threat-level of the pain makes it especially challenging when assessing anxiety towards pain, as fear and anxiety largely depend on the threat-level of the stimulus.

IV) Future Research

Future research may want to further examine athlete pain anxiety in relation to specific types of pain. Not only would this specificity increase confidence in the pain anxiety measures, but this would also create an opportunity to identify the types of pain that do elicit anxiety in athletes. Specifically, athletes my respond more anxiously to concussion-related pain compared to pain from an ankle injury, as concussion has an uncertain prognosis (Kontos, Elbin & Appaneal, 2013, p. 368). This research could not only help inform pain treatment and prevention programs in sport, but may also be timely given the rise in concussion incidence rates over recent years (Daneshvar, Nowinski, McKee & Cantu, 2012, p. 10).

APPENDIX A:
Letter of Consent (Phase 1)

Letter of Consent

Some basic guiding principles for the partnership between the researchers and the participants:

I have read the information sheet for this study and have been given permission to print any information I wish. I have also been provided a contact number of the Principal Investigator and an invitation to ask questions about the study or my participation in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected and I give consent for any data already given to be retained and used.

I understand that I will not benefit financially if this study leads to the development of education and training or future research/education/technological developmental outcomes.

I know how to contact the study team if necessary. I understand that I can contact the UPEI Research Ethics Board at (902) 620-5104, or by email at reb@upei.ca if I have any concerns about the ethical conduct of this study.

I understand that by submitting the letter of informed consent with this study I am agreeing to participate in this study.

I understand that a written summary of the findings will be available to participants through reports produced by the study team and disseminated via professional and academic journals and conferences.

If you would like to participate in this research, please print this page and sign your name and date on the lines below. Please bring this form with you when you visit the UPEI Evaluation Clinic in the lower level of the Steel Building. This signed form is necessary for you to participate.

I have read the information provided for the research conducted at UPEI related to establishing baselines for concussion screening as described in the associated information page. My questions have been answered to my satisfaction and I agree to participate in this study. I voluntarily choose to participate in this study, but understand that my consent does not take away my legal rights in the case of negligence or other legal fault of anyone who is involved in this study. I have been given a signed copy of this consent form.

☐ By checking this box I am allowing any test results to be shared with UPEI healthcare professionals (ex. Physiotherapists or team doctors) or coaches

Name of Participant: ______________________________________

Signature: ______________________________________

DATE: ____________________________

After printing this page, please click on the link entitled to Participation Information to begin surveys, below.

APPENDIX B:
Letter of Consent (Phase 2)

Examining Pain Anxiety in Young Adult Athletes

Primary Researcher: Gillian Potter, MSc Candidate
gpotter@upei.ca
Supervisor: Dr. William Montelpare
wmontelpare@upei.ca

Letter of Consent

It is no surprise that athletes demonstrate high incidence rates of injury. However, this places importance on pain coping in the context of sport. Not only does effective coping facilitate quick recovery and return-to-play, but it also prevents the development of a chronic pain condition following an injury. In order to successfully treat sport-related injuries, we need to have an understanding of what determines athletes' responses to pain. This study looks into the factors behind pain anxiety, or fearful and anxious responses to pain.

We are inviting all healthy, young adult athletes (i.e. you play an organized sport) from the local area to participate in this study. You will benefit by knowing you have contributed to research in this area. Participation entails completing a series of health-related questionnaires pertaining to your physical and psychological characteristics. This may take anywhere from 10 to 20 minutes to complete, depending on your responses. All information collected is strictly confidential. It will be stored in a secure database for a maximum period of 5 years. There will be no consequences if you wish to withdraw from the study or refuse to answer any questions at any point while completing the questionnaires.

If you have any questions pertaining to this study, feel free to contact the researchers via email.

I understand that I can contact the UPEI Research Ethics Board at (902) 620-5104 or by email at reb@upei.ca if I have any concerns about the ethical conduct of this study.

I understand that the information will be kept confidential within the limits of the law.

If you wish, you may print a copy of this consent form to keep.

By submitting your name and date, you are agreeing to participate in this study.

APPENDIX C:
Demographics

Name:_________________________________

Age:_____________

Gender: **M** **F**

Sport:_________________________________

School (if applicable):____________________

Do you have any medical conditions? **YES** **NO**

If so, please indicate:________________________

Have you been prescribed any form of medication in the past 6 months? **YES** **NO**

If so, please indicate:_________________________

APPENDIX D:
Pain Anxiety Symptoms Scale-20

Please respond to the following statements by reflecting on how you typically react to pain.

	Never (0)				Always (5)
1. I can't think straight when in pain.	0	1	2	3	4	5
2. During painful episodes, it is difficult for me to think of anything besides the pain.	0	1	2	3	4	5
3. When I hurt, I think about pain constantly.	0	1	2	3	4	5
4. I find it hard to concentrate when I hurt.	0	1	2	3	4	5
5. I worry when I am in pain.	0	1	2	3	4	5
6. I go immediately to bed when I feel severe pain.	0	1	2	3	4	5
7. I will stop any activity as soon as I sense pain coming on.	0	1	2	3	4	5
8. As soon as pain comes on, I take medication to reduce it.	0	1	2	3	4	5
9. I avoid important activities when I hurt.	0	1	2	3	4	5
10. I try to avoid activities that cause pain.	0	1	2	3	4	5
11. I think that if my pain gets too severe it will never decrease.	0	1	2	3	4	5
12. When I feel pain I am afraid that something terrible will happen.	0	1	2	3	4	5
13. When I feel pain I think I might be seriously ill.	0	1	2	3	4	5
14. Pain sensations are terrifying.	0	1	2	3	4	5
15. When pain comes on strong I think that I might become paralyzed or more disabled.	0	1	2	3	4	5
16. I begin trembling when engaged in activity that increases pain.	0	1	2	3	4	5
17. Pain seems to cause my heart to pound or race.	0	1	2	3	4	5
18. When I sense pain I feel dizzy or faint.	0	1	2	3	4	5
19. Pain makes me nauseous.	0	1	2	3	4	5
20. I find it difficult to calm my body down after periods of pain.	0	1	2	3	4	5

Sub-Scales
Cognitive: Items 1-5
Escape/Avoidance: Items 6-10
Fearful: Items 11-15
Physiological: Items 16-20

APPENDIX E:
Depression Anxiety Stress Scale-21

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

<u>The rating scale is as follows:</u>

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of the time
3 Applied to me very much, or most of the time

1. I found it hard to wind down.	0	1	2	3
2. I was aware of dryness of my mouth.	0	1	2	3
3. I couldn't seem to experience any positive feeling at all.	0	1	2	3
4. I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion).	0	1	2	3
5. I found it difficult to work up the initiative to do things.	0	1	2	3
6. I tended to overreact to situations.	0	1	2	3
7. I experienced trembling (e.g. in the hands).	0	1	2	3
8. I felt that I was using a lot of nervous energy.	0	1	2	3
9. I was worried about situations in which I might panic and make a fool of myself.	0	1	2	3
10. I felt that I had nothing to look forward to.	0	1	2	3
11. I found myself getting agitated.	0	1	2	3
12. I found it difficult to relax.	0	1	2	3
13. I felt down-hearted and blue.	0	1	2	3
14. I was intolerant of anything that kept me from getting on with what I was doing.	0	1	2	3
15. I felt I was close to panic.	0	1	2	3
16. I was unable to become enthusiastic about anything.	0	1	2	3
17. I felt I wasn't worth much as a person.	0	1	2	3
18. I felt that I was rather touchy.	0	1	2	3
19. I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat).	0	1	2	3
20. I felt scared without any good reason.	0	1	2	3
21. I felt that life was meaningless.	0	1	2	3

<u>Sub-Scales</u>
Depression: Items 3, 5, 10, 13, 16, 17, 21
Anxiety: Items 2, 4, 7, 9, 15, 19, 20
Stress: Items 1, 6, 8, 11, 12, 14, 18

APPENDIX F:
Athlete Identity Measurement Scale

For the next 10 questions, please circle the number which corresponds most closely to your personal thoughts, feelings, and experiences. For each item indicate on a scale from (0) strongly disagree to, (4) strongly agree. Please circle only one response (number) per item.

0 = Strongly Disagree
4 = Strongly Agree

1. I consider myself an athlete.	0 1 2 3 4
2. I have many goals related to sport.	0 1 2 3 4
3. Most of my friends are athletes.	0 1 2 3 4
4. Sport is the most important part of my life.	0 1 2 3 4
5. I spend more time thinking about sport than anything else.	0 1 2 3 4
6. I need to participate in sport to feel good about myself.	0 1 2 3 4
7. Other people see me mainly as an athlete.	0 1 2 3 4
8. I feel bad about myself when I do poorly in sport.	0 1 2 3 4
9. Sport is the only important thing in my life.	0 1 2 3 4
10. I would be very depressed if I were injured and could not compete in sport.	0 1 2 3 4

<u>Sub-Scales</u>
Self-Identity: Items 1, 2, 6
Social Identity: Items 3, 7
Exclusivity: Items 4, 9
Negative Affectivity: Items 8, 10

APPENDIX G:
Injury Reporting Form

1. Do you have any form of chronic pain? (Chronic pain is classified as any type of pain you have experienced for at least 3 months).

YES NO

If yes, in what region of the body is it located? _________________

2. On average, how often did you experience pain in the past 6 months? (Acute or Chronic)

0 = No Pain
1 = Less than once every 3 months
2 = Once or twice every 3 months
3 = Twice a month
4 = Once a week
5 = Twice a week
6 = Everyday

3. On average, how intense was the pain you experienced in the past 6 months? (Acute or Chronic)

No Pain (0)	**Moderate Pain (5)**	**Severe Pain (10)**

0 1 2 3 4 5 6 7 8 9 10

4. How many injuries have you sustained in the past 6 months?

____

5. If you have sustained an injury, please indicate the type of injury/injuries:

____

6. How much playing time did you miss from the injury/injuries?

0 = Did not sustain an injury
1 = None
2 = 1-2 days
3 = 3-4 days
4 = 5+ days

7. Over the past 6 months, have you sought medical attention for injury? (e.g. physician, physiotherapist, trainer)

YES NO

If Yes, how many times did you receive this care?

1 = 1-2 times
2 = 3-4 times
3 = 5-6 times
4 = 7-9 times
5 = 9-10 times
6 = 10+ times

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